PETROLEUM PROCESSING

including Petrochemical Processing Section

SEPTEMBER 1952

Petrochemical Forecast

Output will increase more than 5-fold by 1975 —p. 1289

Power for Your Plant

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"Hot Atom" Instrument

Measure level of corrosive liquids from the outside —p. 1286

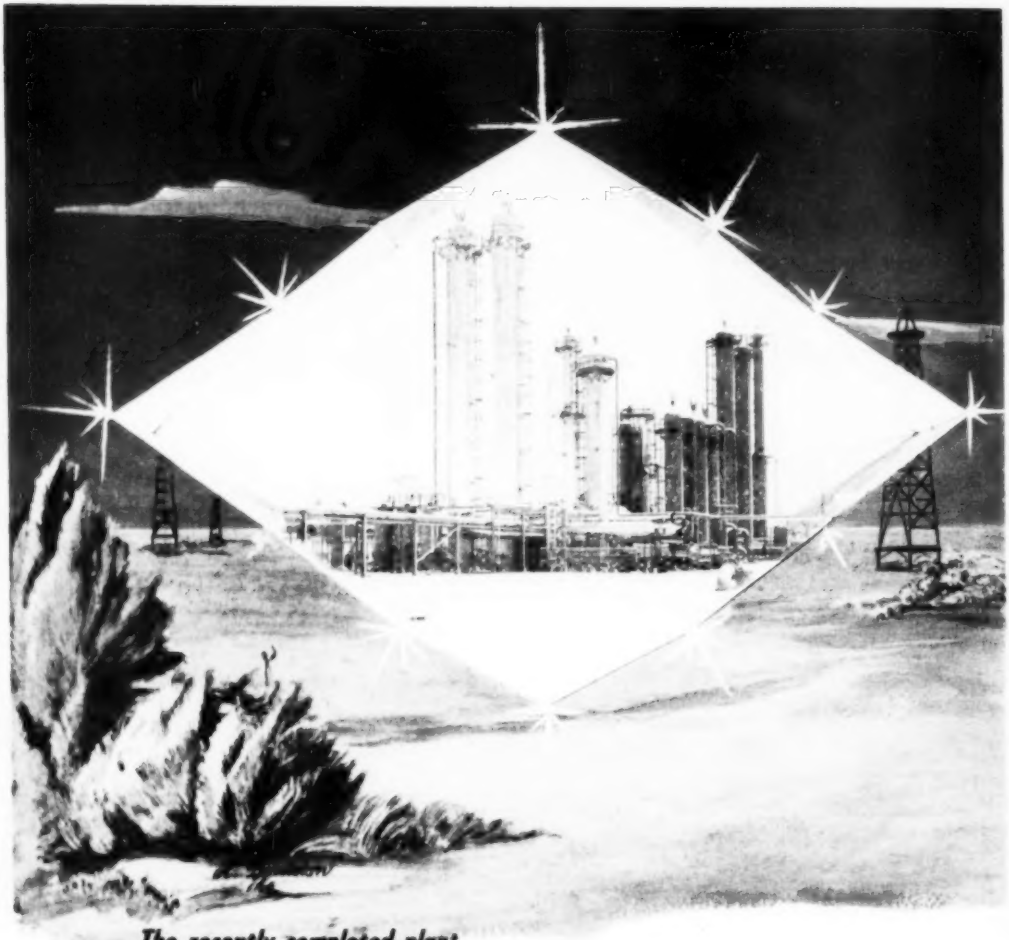
Canadian Petrochems

Roundup of new and expanding plants across the border —p. 1306

What Causes Engine Wear?

Recent studies indicate that plain, old-fashioned friction is the primary trouble—not corrosion or abrasion

—p. 1263



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Good ideas are like snowballs

When you start one rolling, there's no telling how far it will go or how big it will grow.

For example, several years ago, we received a letter from an oil marketer in Michigan, enclosing an invoice for some gasoline he had purchased back in the 1920's. He noted that the current price of gasoline, excluding taxes, was no higher than a quarter century ago, and he wondered how the actual *value* of the gasoline compared with that of 1925.

We knew there was a good idea here, and so we decided to do some research on the subject. It sounded like an easy question to answer, but we soon discovered it wasn't. We had to trace the separate contributions of the oil and automotive industries through the years. We had to develop a continuous record of octane

Continued on next page

ETHYL
ANTIKNOCK COMPOUND
ETHYL CORPORATION

Good ideas are like snowballs

Continued from preceding page

numbers—as measured by today's scale, and we had to determine the road performance of these gasolines in contemporary cars of the various years.

Finally our study was completed. We were able to report back to the Michigan oil marketer that, by any real standard, the value of gasoline had increased approximately 50% in the last quarter century. In other words, *two gallons of today's gasoline will do the work that required three gallons in 1925!*

This was news! Here, in one short sentence, was the whole story of the tremendous job American petroleum refiners had done for the public in the past twenty-seven years! It was a record to be proud of. So we took the "2 = 3" story to the country in public demonstrations in Detroit; Washington, D. C.; Newark, N. J.; Los Angeles; and Chicago. Newspapers across the country picked up the story. Magazines ran feature articles about it.

And the idea is still snowballing! This year, the OIC is using the "2 = 3" idea in its theme for Oil Progress Week, *"Two gallons of modern gasoline provide the same work energy that required three gallons in 1925."*

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September 1950

NEW JERSEY TURNPIKE
Oil Progress Week, 1951

WASHINGTON, D. C.
Oil Progress Week, 1950

CHICAGO, ILL.
August 1952

POMONA, CALIF.
April 1952

ETHYL "2 = 3" BOOK
published September, 1950

HOW TO CONDENSE A CONDENSER

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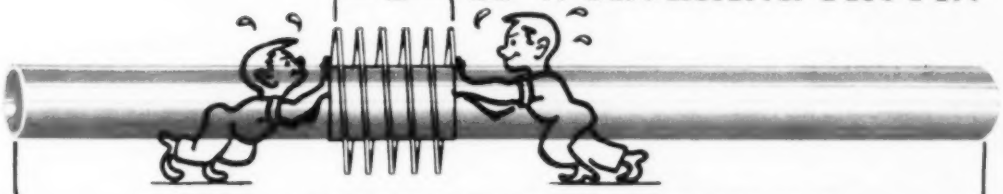

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PETROLEUM PROCESSING

Covering petroleum research and the design, management, operation and maintenance of plants processing hydrocarbon materials, into fuels, lubricants and chemicals

September, 1952
Vol. 7, No. 9

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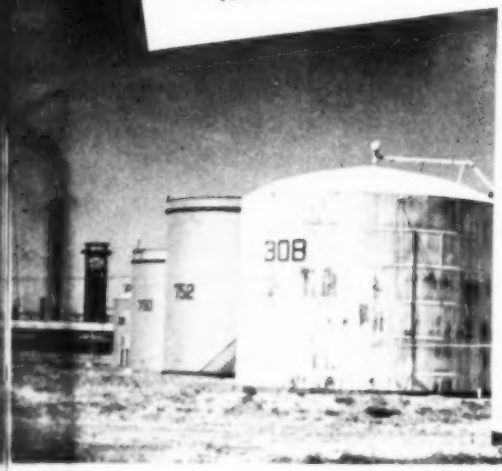
DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

A refinery asked:

"How Fast Can You Clean Storage Tanks?"



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Dowell Service cleaned *FIVE* . . . in just 40 hours

Storage tank cleaning has been speeded up by Dowell Service! That's what many operators say about the new Dowell method, using thickened chemical solvents.

A rust film had collected on the inside walls of five coal tarred storage tanks in a refinery. This film had to be removed to permit storage of a different product. Dowell engineers, using thickened solvents jetted through lances, cleaned the walls of all five tanks in just 40 hours. These thickened solvents — developed by Dowell — are designed to cling to vertical walls—dissolve unwanted deposits.

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Other recent Dowell jobs:

Gas washer and mains in a steel plant were cleaned by Dowell Service in 7 hours. Pressure drop across washer was reduced from 60" to 6".

•

Dowell Service increased capacity of a fractionating bubble tower from 500 gallons per minute to its original capacity of 800 g.p.m.

•

Flow through 400 feet of 4 inch water line had dropped to 125 gallons per minute. Dowell Service increased the flow rate to 228 g.p.m.

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Publisher's Page

Join Us on the Meeting Merry-go-Round

Labor Day had special significance to our editors as the starting whistle for a three month convention scramble that tries their physical endurance almost as much as it does that of equipment salesmen. The advantage, however, lies with our editors in that their retiring hours are of their own choosing.

The annual circuit is getting off to a better than ever start this year with thirteen September meetings selected for personal coverage by our Petroleum Processing staff. With Dave Thornton, our Southwestern Editor, just returning from a two month special editorial assignment in Mexico, most of the load of reporting to you on the important new technical developments presented at these meetings will be carried by the rest of the staff.

The Instrument Society of America's annual meeting in Cleveland the week of September 8th probably has the widest range of interest to you. Bill Uhl, who has covered this meeting alone for the past five years, will be assisted by Gene Gibbons this year because of Bill's dual capacity as Chairman of the ISA publicity committee. Look for their report in our October issue.

Editor Virg Guthrie goes down to Atlantic City's famed Boardwalk, where the National Petroleum Assn. is holding its 50th annual meeting September 10-12, and the American Chemical Society gathers the following week.

Bill Bland, Engineering Editor, will log most of the mileage this month with Chicago's Centennial of Engineering, September 3-13, as his starting point followed by trips to Houston, Kansas City and Casper, ending up there for the WPRA regional meeting September 25-26.

The 25th promises to be a real rat race. Aside from the WPRA meeting in Casper, the Independent Oil Compounders Assn. starts its meeting in Chicago and Canadian Oil's new refinery is scheduled for dedication—all on the same day and right in the middle of closing forms on the October issue.

As a regular reader of PETROLEUM PROCESSING, you will have the advantage of sitting in on all of the technical meetings of importance to you this fall without traveling any further than to your front mail-box and returning to your favorite easy chair for two or three hours once a month.

To make this possible, PETROLEUM PROCESSING maintains the largest and most experienced editorial staff exclusively devoted to reporting on the petroleum processing industry. While we rely on top authorities in the industry for reports on highly specialized and technical subjects, we feel that the number and experience of our own staff pays off for you and is essential to a well-rounded editorial content. Coverage of the convention circuit is just one of many such examples.

A. W. Boulton

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National Petroleum News
The weekly oil marketing magazine, covering news, prices, transportation, storage, merchandising

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What's Happening . . .

Expansion

. . . **Present status of refinery expansion** was reported last month by Deputy Petroleum Administrator J. Ed. Warren. Since the beginning of the Controlled Materials Plan in 1951, 819,000 b/d of new crude charging capacity have been started, and a total of 1,215,000 b/d is planned for construction. Breakdown of status of new crude charging, catalytic cracking and catalytic reforming facilities (given in b/d as of July 7, 1952) follows:

	Crude Charging	Catalytic Cracking	Catalytic Reforming
Construction Completed	92,950	87,190	10,920
Construction Started*	819,207	563,040	86,565
Estimated Completion *			
By Jan. 1, 1953	528,602	279,620	55,500
By July 1, 1953	742,162	374,220	70,125
By Jan. 1, 1954	1,078,107	622,740	173,685
Later	1,215,032	686,820	221,295

* Figures include completions shown in first line.

. . . **Standard of California** will spend more than $20 million on new facilities for its El Segundo, Calif., refinery. Included will be a 54,000 b/d feed preparation unit and a 36,000 b/d catalytic cracker. Design of catalytic unit has not been announced, nor contracts let. Actual construction is expected to begin in mid-'53, with completion scheduled for 1954.

. . . **Shell Oil Co.** has let construction contract to Procon, Inc., for a new 16,000 b/d UOP Platforming unit at its Wood River, Ill. refinery. Unit will be designed primarily for production of high octane motor fuel. Construction is scheduled to start immediately.

. . . **Ohio Oil Co.** will install a new 8,000 b/d Houdriforming catalytic reformer at its Robinson, Ill. refinery. Contracts have been let to Houdry Process Corp., with construction to be done by Catalytic Construction Co. and scheduled for completion in late '53.

. . . **Standard of Indiana** plans to double size of its proposed new refinery at Mandan, N. Dak., to 30,000 b/d (see What's Happening, Feb. '52), and to build a products pipe line from it to company's Fargo-Moorhead pipe line terminal.

. . . **American Liberty Oil Co.**, Dallas, has let contract to Fluor Corp. Ltd. for modernization of its 11,000 b/d refinery at Mt. Pleasant, Texas. Included will be new feed preparation facilities, Thermofor catalytic cracking unit, gas fractionation, and modification of existing polymerization plant.

. . . **Shell Oil Co. of Canada** will more than double capacity of its refinery at Vancouver, B. C., bringing it to 15,000 b/d, in a $10 million construction program just announced. General contracts have been let to Fluor Corp. Ltd., and include Fluid catalytic cracking, vacuum flashing, gas recovery, polymerization and treating units, plus new office buildings and shops and additional product storage.

. . . **Kerr-McGee Oil Industries, Inc.**, has let contract to Dressering Engineering Co., Tulsa, for an $850,000 natural gasoline recovery plant in Moore County, Texas. Plant will process 55 MMcf. daily, recovering 50,000 gal. of liquid hydrocarbons.

. . . **Carter Oil Co.** is building a catalytic polymerization unit at its Billings, Mont. refinery, with Chemical Plants Division of Blaw-Knox Co. handling design, procurement and construction. Unit will charge 3,700 Mcf./day of gas, producing 600 b/d of 100-plus octane polymer. It is described as a "high pressure shell and tube type reactor unit employing solid phosphoric acid catalyst."

. . . **Paragon Refining Corp.**, Newark, N. J. has received a certificate of necessity for over $25 million for "oil refinery facilities." Company is affiliated with Paragon Oil Co., large fuel oil distributors in east, and according to some reports is going to build avgas facilities.

Petrochemicals

. . . **Benzene production by petroleum industry** will exceed expansion goals presently programmed by Defense Production Administration. Program set up in 1951 by DPA called for building new facilities to produce 8,450 b/d (130 million gallons annually) of benzene from petroleum sources by 1954. By mid-June 1952, DPA had approved certificates of necessity to cover this amount. However, on the basis of applications for construction approval filed with PAD, the petroleum industry plans to build 18 new facilities with an aggregate capacity of 9,016 b/d. Construction has already started on 13 of these, and completion of 7,510 b/d is expected by July 1, 1953, with 8,156 b/d finished by Jan. 1, 1954.

. . . **Standard of California** will start construction next year of new facilities at its El Segundo, Calif. refinery for the manufacture of cumene, which will then be shipped north to the company's Richmond refinery for conversion to phenol (see What's Happening, Nov. '51, p. 1188). Raw material for the cumene will be propylene, to be recovered from new 36,000 b/d catalytic cracking unit now being designed for El Segundo. Cumene project was originally intended for Salt Lake City, Utah refinery of Salt Lake Refining Co., a Standard of California subsidiary, and a $1,760,000 certificate of necessity for it was issued last February.

. . . **Carbide and Carbon Chemicals Co.** will build its new $36 million petrochemical plant on a 140-acre site adjacent to General Petroleum's Torrance, Calif., refinery. Carbide recently purchased the site from GP and has entered into a 20-yr. contract with the latter to supply it with raw materials from refinery

gases. Products will include polyethylene and ethylene glycol (see What's Happening, Aug. '52, p. 1055).

. . . **Sinclair Chemicals Inc.** is a new subsidiary of the Sinclair Oil Corp., set up to take over production and sales of petrochemicals heretofore handled by the petrochemical division of Sinclair Refining Co. The new company is to expand operations in the petrochemical field and will have its own research staff and market development department. They will have the use of the research facilities of Sinclair Research Laboratories, Inc. Headquarters of the new subsidiary are located in the Sinclair Oil Bldg., 600 Fifth Ave., New York.

. . . **Heyden Chemical Corp.** denies reports that its contemplated $12 million methanol plant on the Houston Ship Channel has been "shelved" due to recent steel strike. Company Official told PETROLEUM PROCESSING that final decision has not yet been reached on whether or not to proceed with construction, but emphasized that delay "was not occasioned by the steel strike."

. . . **Monsanto Chemical Co.** has begun construction of a plant for phenol manufacture on an 86-acre site near Avon, Calif. Using a process recently developed by the company, the new plant is expected to be in operation by early '54. It is being jointly built and operated by Monsanto's Western and Organic Chemicals Divisions.

. . . **Chemical Corp. of California,** a newly-formed company, will build a 100 ton-day anhydrous ammonia plant at Oleander, Calif., in the San Joaquin Valley. Ammonia is to be used for agricultural and industrial use. Location has available natural gas and a surrounding agricultural consuming area.

. . . **Phillips Chemical Co.** has begun operations of its second sulfur plant, located in West Texas adjacent to Phillips Petroleum Co.'s Crane gasoline plant. Although designed to extract 100,000 lbs. of sulfur day from natural gas, initial production has exceeded 10% of design capacity. Plant's output will be eventually converted to ammonium sulfate at the company's Adams Terminal plant.

. . . **Dow Chemical Co.** plans a new ethylene unit at its Freeport, Texas plant, and has received a certificate of necessity covering $6,675,000 for the project. Construction is scheduled for completion in 1954.

. . . **U. S. Rubber Co.** is converting Port Neches, Texas GR-S synthetic rubber plant operated by its Naugatuck Chemical Division from "hot" to "cold" rubber and increasing capacity from 70,000 long tons yr. to more than 100,000. Program will cost about $2.5 million, and is expected to be completed by late fall.

Miscellany

. . . **Trans Mountain Oil Pipe Line Co.** now plans to have three pumping stations on its new crude line from Edmonton, Alberta, to Vancouver, B. C., instead of two. Result will be that initial capacity will be 120,000 b/d, instead of only 75,000.

. . . **Norwalk Oil Co.,** which has an 8,000 b/d refinery at Bakersfield, Calif. and 365 b/d natural gasoline plants at Maricopa and Santa Fe Springs, Calif., has been merged with Bankline Oil Co. and will take the latter name.

. . . **Aluminum and copper supplies** under existing government controls are now sufficient to meet all important defense and civilian needs, according to Defense Production Administration. Steel supplies, tightened as result of loss of 2½ months of steel production because of strike since March '52, are expected to return during first quarter '53 to approximately the situation existing prior to the strike in most steel products.

Markets, Prices

. . . **Falling prices for heavy** fuels continued to dominate oil markets in August. Settlement of steel strikes failed to reverse the downward trend which has been under way since early Summer. Glut of residual was such that it was interfering with output of gasoline and distillates, tightening still more the already tight market for the latter two products.

Drop of 15c to $1.50 bbl. for Bunker "C" fuel in the cargo market at the Gulf touched off a general reduction in terminal prices along the East and Gulf Coasts. Esso Standard, in reducing its postings in amounts ranging from 13c to 36c per bbl., said that the cuts reflected not only a general weakening in prices for residual fuel in primary markets, but also the lower levels reached in tanker transportation rates. Other companies followed Esso's cut, and No. 6 oil, no sulfur guarantee, was quoted at $2.10 bbl. in barge lots at New York harbor, down 25c.

. . . **Reductions in refinery runs** were made at some plants at the Gulf and in the Caribbean in an effort to curtail residual production. Cuts ranged from a few thousand b/d up to 25,000 b/d. Largest cut has been at one plant in the Caribbean where crude runs, because of heavy fuel surplus, have been curtailed a total of 85,000 b/d to date.

Forced reductions in crude runs in turn stepped up demands for gasoline and distillate fuels from many primary suppliers who, following the oil strikes in May, had found it touch and go in meeting their contract commitments. Prices for the lighter products accordingly were firm.

. . . **Depressing factor in heavy fuel situation,** according to some trade sources, is large number of oil-burning dry cargo ships tied up as result of curtailed exports. Of total of 6,000 ships (all flags), between 1,500 and 1,800 are in "moth balls." As to possibilities of weaning utility and industrial customers away from coal, they believe this will be a slow operation—barring a John L. Lewis-called general coal strike in September.

. . . **Natural gasoline rallied sharply** as demand from refiners, for blending winter motor fuels, increased. Prices for Grade 26-70 were up 0.875c, to 6.375c, FOB Group 3, and 5.875c, FOB Breckenridge. At these levels, prices are within 0.5c of ceilings.

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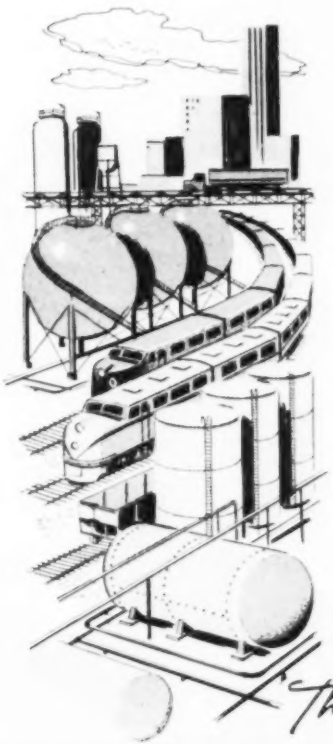

1. Insul-Mastic *superior* coatings provide extra long term protection. This is due to the superior ingredients from which they are manufactured and is attested to by Weather-O-Meter tests and actual field applications of many years duration.

2. Insul-Mastic *superior* coatings with their Gilsonite base are practically inert. Therefore, they are resistant to almost all acids and alkalis.

3. Insul-Mastic *superior* coatings keep surfaces dry. The moisture vapor transmission rate is only .01. This makes them ideal for vapor-sealing thermal insulation.

4. Insul-Mastic *superior* coatings can withstand temperatures ranging from −40° F., to + 300° F., without cracking or running.

5. Insul-Mastic *superior* coatings contain an extremely high percentage of solids and thus, can generally be built up to their specified thickness in a single application . . . and, their shrinkage on drying is greatly minimized.

Think first of the coatings that last!

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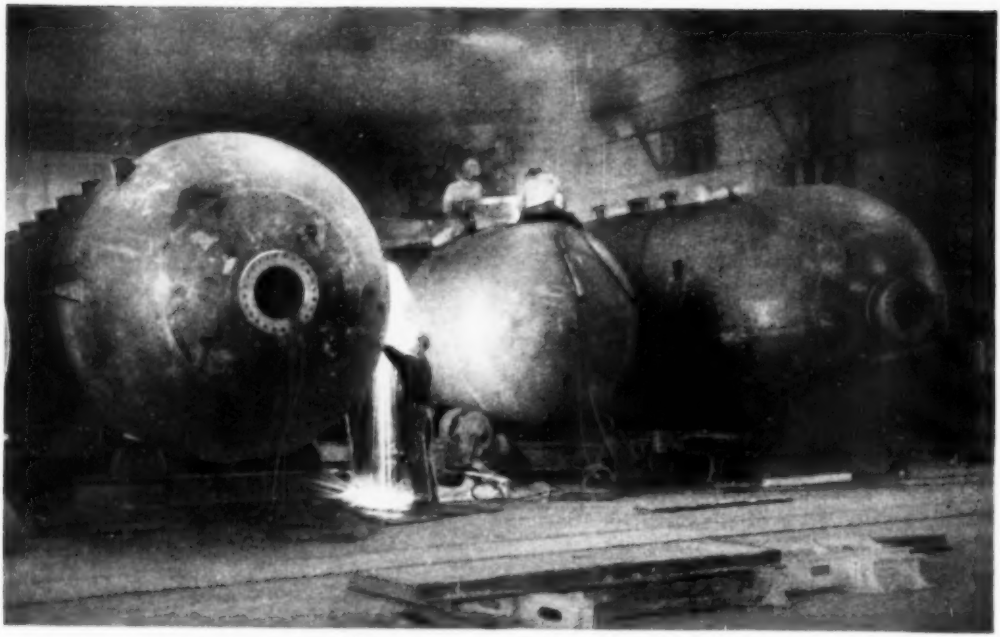

An excellent example of Graver's skill in fabricating pressure vessels is this 10' x 32' desalting tank for use in a new refinery unit now under construction. The tank was built for an operating pressure of 300 psi.

Something Special

IN PRESSURE VESSELS

The steady growth of the petroleum, petro-chemical and chemical industries has greatly increased the demand for specialized equipment, particularly new types of pressure vessels.

Graver's production facilities and skilled craftsmanship have provided the answer to pressure vessel problems for many years. Every Graver-built pressure vessel is fabricated in accordance with the ASME Code for unfired pressure vessels, the API-ASME Code as adapted to the special requirements of the petroleum industry, or to the even more stringent requirements set by customers. Complete X-raying, stress relieving and equipment for rigid inspection are additional features which assure that every fabrication will measure up to the requirements expected of it.

Whether fabricated in steels, clads or alloys, every pressure vessel bearing the Graver nameplate bears the symbol of quality.

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GRAVER

No Let-up Foreseen in Expanding Production of Synthetic Fibers

SYNTHETIC fiber will provide an increasingly attractive market as a major outlet for products of the petrochemical processing industry in the future, according to one industry authority.[1]

Total production can be expected to increase 300% between 1950 and 1953, it was said, with an installed capacity of over 400,000,000 lbs. next year. By 1970, output of non-cellulosic synthetics should reach close to 1,000,000,000 lbs. annually. At the same time, the cellulosic fibers are expected to double approximately.

Today's price relationship among some of the fibers will also change, it was stated. The acrylic fibers such as Orlon and Acrilan—highest in price now—will drop below such materials as nylon and Dacron and eventually be second only to the regular cellulose staples.

A similar growth in production of synthetic fibers outside the United States can be anticipated also. There are already 29 foreign companies making nylon fibers, 27 making glass fibers, 9 on polyvinyl chloride, 6 on polyvinyl alcohol types, and 4 on protein staples.

Acrylic fiber made the big news during the present year, with large productive capacity expansion programs completed or underway in such products as du Pont's Orlon, Chemstrand's Acrilan, Cyanamid's X-51, Industrial Rayon's acrylic fiber, and two others as yet un-named. Up until now, principal manufacturing had been in the form of filaments, but the predictable future indicates a growth in the form of staple fibers.

Either way, no matter how it comes out, the petrochemical industry knows that what goes in has to be more and more raw materials. W. C. U.

(1) C. W. Breidigs, American Cyanamid Co., speaking at the American Society for Testing Materials 55th annual meeting, New York City, June 23-27, 1952.

How Will the Williston Basin Affect The Country's Refining Situation?

THE Williston Basin in North Dakota—scene of the nation's newest and most talked-about crude oil pool—is believed by many exploration crews now to be possibly the biggest reserve in the country.

So far, drilling has been the major activity. But as the Basin continues to develop, at least one of the questions which arise are of importance to the petroleum processing industry: Where will the oil be refined? A recent special staff report by *National Petroleum News* has analyzed the situation and come up with a few answers.[1]

To begin with, the crude oil's shortest trip will be to new refineries in that same area. Industry economists hesitate to speculate on how much crude will be refined and consumed locally, because of such variables as population shifts and new commercial development. But at least two local refineries are in the works. Standard Oil Co. (Indiana) has taken options on 900 acres at Mandan, N. Dak. as the site of a new 30,000 b/d facility. Depending on crude development, the plant is scheduled to be ready to go into operation in mid-1954. In the drawing board stage is the announced plan of Williston Refining Co., an independent, for a 10,000 b/d refinery for an estimated $8,000,000, somewhere in the Williston area, possibly at Bismarck.

Output of these two refineries is believed generally to be sufficient for local needs for some time to come, even though demand is stimulated to new highs because of people and businesses settling in the area.

However, it also appears certain that the crude production from the Basin itself will exceed local refining capacity, building up pressure for new, outside markets. Economists feel this will move the crude along several paths.

One destination would be to the refineries and large-consuming areas of Minneapolis-St. Paul, Duluth, and Chicago. Actually, some crude shipments by pipe line and rail have already started last February to Northwestern Refining Co. in St. Paul. A direct line to Chicago is a possibility, but connections with Service Pipe Line or the Platte Pipe Line are considered more likely. Another route possibility is south to meet existing lines to Kansas City and St. Louis.

Though not expected for some time to come, the Southwest should eventually feel the impact of this new movement of refinable materials from Williston into the Midwest. An adjustment between the two great producing areas will have to come, but it is believed it will be a gradual change with no turmoil. W.C.U.

(1) "Williston Crude—Where's the Market," Petroleum Publication, National Petroleum News, August 27, 1952, pp. 46-48.

Contaminants in The Oil As Source of Engine Wear

INDICATIVE of the increased attention being given the causes of engine wear in automotive vehicles is a study by the Engineering Staff of Ford Motor Co.[1] This authority differs from another report published in this issue (p. 1263)[2] in ascribing more importance to contaminants in crankcase oil as a factor in engine wear and their control by means of oil filters. Both agree upon the public's interest in the latter as related to vehicle life.

"Today's progress in the development of the automotive engine," it is stated, "is marked by frequent announcements of new engine designs with lower frictional losses, higher compression ratios and horsepower ratings, offering greater economy and thrilling new performances in driving; but we cannot afford to forget that the consumer will ultimately measure our progress in terms of 'engine life'."

The Ford investigation involved a study of engine wear in 20,000 miles of operation relative to the effects of engine oil conditioning by periodic oil changes and oil filtration. The tests were conducted with vehicles from the Ford Motor Co. transportation car pool operating in the Detroit area, to avoid the personal driving habits of one operator and obtain a thorough cross-section of drivers. Separate studies were made to determine to what extent engine wear is affected by operation with fuels containing octane improvers, inhibited oils containing appreciable quantities of detergent additives, and air cleaners of different efficiencies.

The oil film picks up foreign contaminant particles

introduced into the engine through manufactured dirt, compounds formed in the process of burning fuel, air entering the engine as part of the combustion process and for ventilation purposes, and products formed from the deterioration of the oil itself, when exposed to high operating temperatures. "Whether or not there would be engine wear when we have successfully isolated all of these sources of contaminants, would depend a good deal on the ability of the oil to lubricate, and on the engine design to provide this oil supply in a manner suitable for the lubrication of each part of the engine. . . .

"The full-flow oil filter of this area is by far the best method we have seen for restricting wear in an engine emanating from contaminants that get inside the engine."

The need for directing greater attention to the essential lubricating qualities of motor oils is recognized by these authors, as means are found for lessening the contaminant load and improving piston ring operating conditions so that the need for high concentrations of detergent additives in the oil will disappear. —V.B.G.

(1) "Can All Engine Wear be Trapped in a Can?", Robert J. Piccoli, Ford Motor Co., presented before Society of Automotive Engineers National West Coast Meeting, San Francisco, Aug. 11-14, 1952. (2) "Factors in Main Cause of Engine Wear", Dean's paper. How Engine Wear, J. F. Kincaid, G. A. Martinez, L. E. Moody, Esso Laboratories, Research Division, Standard Oil Development Co., presented before Society of Automotive Engineers National Meeting, Atlantic City, June 16, 1952.

Diesels Are Not as Finicky About Fuel as Once Believed

TEST work on high speed Diesel power reported by The Texas Co. serves to further disprove the earlier general thinking that all cracked oils are undesirable fuels.(1) The problem of how to secure greater yields of automotive grade Diesel fuels, if required, was attacked by this company from two angles; utilization of available refinery stocks and improvement of refining methods. The findings revealed that much Diesel equipment was not as particular about its fuel diet as had been anticipated.

When future anticipated demands appeared to exceed the available supply of virgin gas oils, light cycle gas oils with physical properties approaching those of virgin gas oils had been turned to as the most available material to make up a deficit in virgin gas oils. "Common thinking was that these cracking materials would promote heavy engine deposits," it was stated. "Therefore, it appeared desirable to actually determine whether small amounts of cracked stocks would degrade the performance quality of virgin gas oils. Stocks were obtained from two refineries whose crude sources were widely different.

"In blending these stocks," it was found, "up to 10% of the cracked stocks could be included in the virgin gas oil from each refinery and still obtain the physical characteristics of an excellent automotive Diesel fuel."

To determine what effect on engine performance these blends would have, the CFC F-18 test procedure was followed using a crankcase oil of the specification normally recommended for this type engine. The test differentiates fuel performance with regard to deposit formation, exhaust smoke and odor, and engine wear. "The results showed no significant difference in performance between the 10% light cycle gas oil blends and the virgin gas oil stocks."

Further tests were made to determine the deposits forming characteristics of assorted blends containing up to 40% cracked stocks. The results in terms of weighed exhaust valve deposits were plotted against increasing cracked stock content of the fuel. The difference in deposit forming tendencies of fuels from different crude sources was pronounced as had been anticipated, making it imperative that cracked stocks from one refinery should be kept at a minimum in fuel blends to assure high quality. However, in the second refinery, no significant differences in injector deposits were noted in up to 40% blended cracked stocks. The deposits were low in all cases. The deposit data were compared to the sulfur content of the blends. "The data obtained were very consistent and indicated no correlation between amount of deposit and sulfur content as evidenced by the appreciable differences in deposits between fuel stocks having the same sulfur content". Stability and storage tests showed no significant differences among the various blends. —V.B.G.

(1) "The Modern Bus and Truck, Fuels and Lubricants—Part 1, Lubrication, published by The Texas Co., August 1952.

"Instrumentology" Suggested as Aid To Scientific Manpower Problem

EFFORTS to solve the perplexing problem of an engineering and scientific manpower shortage have taken many different and interesting approaches these days. What the future may yet bring as a possible solution is still anybody's guess, but at least one scientist believes that a part of the answer may be in increased use of instruments to free the specialized technologist for work for which he is better qualified.(1)

In what is termed "instrumentology centers" in the larger research institutions, designed to apply science to science itself, this authority visualizes the means by which research can become as productive as possible in increasing our fundamental knowledge in science. Such centers could plan the instruments capable of attacking a specific problem, and could design and construct (if necessary) the instruments and other aids required in the research.

Possibly the biggest handicap in the beginning would be the misgivings of the so-called instrumentologist regarding his professional recognition. However, both the scientific specialist and the instrumentologist would be able to gain greater competence in their own fields. The instrumentologist would be extending his skills to problems either presented to him or suggest to the specialists problems on which work could be done.

The center could have a number of functions: training technicians to provide instructions in the use of special instruments; offering courses in instrument fundamentals; and developing courses of study for professional training in the field. All the modern types of instruments would be covered, including electron microscopes, electron and X-ray diffraction, electronic and electric measurement and control, statistical analysis, and computers. W. C. U.

(1) "Instrumentology Centers Eliminate Big Science Overspecialization, A Timely Report Suggests Ways to Train Technicians to Help Top Flight Scientists," Science Service, Inc., 1719 N Street, N.W., Washington 6, D.C. Dr. Lyman J. Briggs, chairman, Committee on Instrumentology, has had long experience in the National Bureau of Standards.

Santolube 70, a new development by Monsanto Research, solves the problem of rust on ferrous metal parts of turbines and other equipment employing oil in closed systems.

Santolube 70 is effective in concentrations ranging from 0.02% to 0.10%. The lower dosage usually is ample protection in light turbine oils. For more viscous oils and where salt water is present, higher concentrations of the additive are recommended.

The new additive has been tested thoroughly, with results proving its efficiency beyond normal operating requirements.

If rusting is a problem with your industrial oils, it will be worth your while to get the details on Monsanto Santolube 70. Write for a copy of the new Monsanto Technical Bulletin No. O-86, which gives test results, typical inspection values and much other useful information. MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

Santolube: Reg. U. S. Pat. Off.

SANTOLUBE 70

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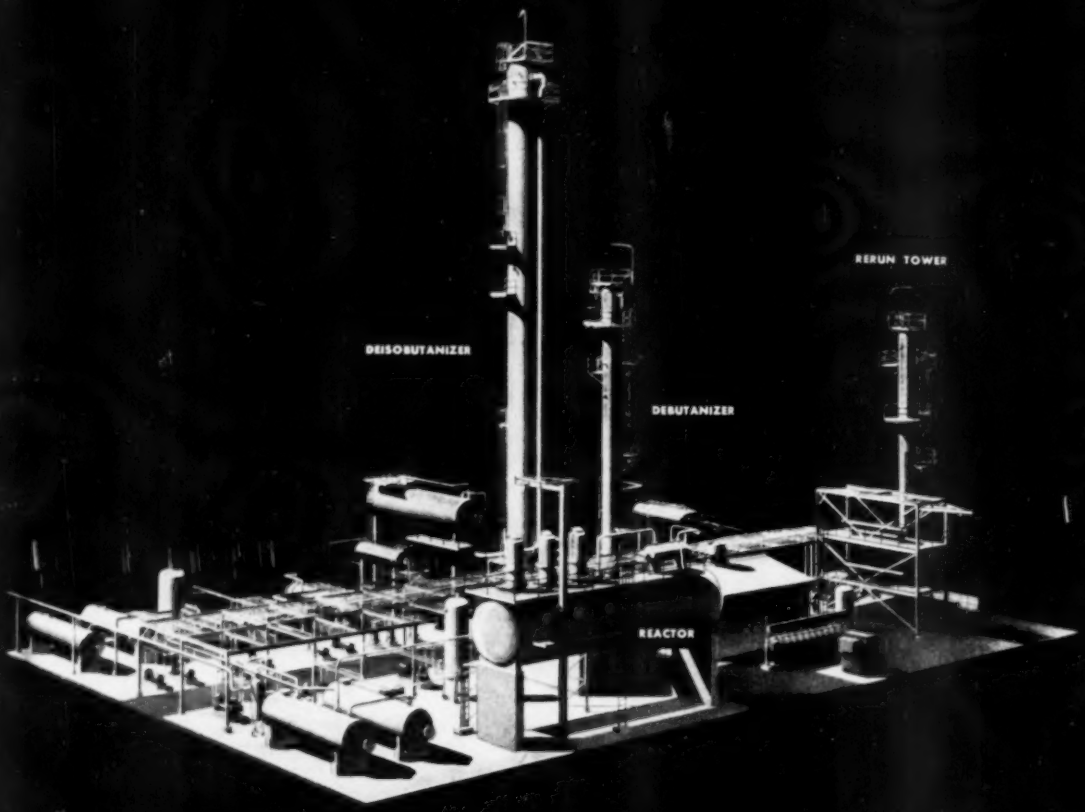
Serving Industry . . . Which Serves Mankind



catalytic alkylation

Embodying all the latest process design improvements in Sulfuric Acid Alkylation, the unit illustrated above—soon to go "on stream"—is one of 14 Alkylation units with a combined output of 35,000 barrels of Alkylate per day, designed and constructed by Foster Wheeler for the worldwide petroleum industry.

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Letters

How to Order

Thank you for sending us the five articles dealing with the subject of "How to Order Equipment" which we requested for use in our training program. I am sure that they will be very valuable to us in this work and as a source of reference in our Technical Library.

W. R. SISLEY
Mgr., Employee Relations
Esso Standard Oil Co.
Baltimore, Md.

● Has it ever occurred to you to find this series of articles in an inexpensive binder, as it certainly could be used to advantage, not only by oil companies but companies such as our own. We have the same problem in training our men to ask the buyer for sufficient information to enable us to quickly place an order with the manufacturer, and in many cases our men fail to secure sufficient information as to equipment being used to enable us to properly stock our stores.

It is my belief that such a series incorporated in a single binder could be a very useful training manual. Certainly I would be interested in having the entire series suitably bound.

CARL C. EGNER
Mgr., Refinery and
Pipe Line Equipment Sales
Oil Well Supply Co.
Dallas, Texas

We considered making binders available at a nominal charge, but dropped the idea after a few spot checks indicated most readers planned to file the articles in their own data files under the individual types of equipment covered in them. If we're wrong, tell us so and we'll see what can be done. Reprints of the individual articles, dealing with valves, pumps, heat exchangers, instruments, compressors, and cooling equipment (the latest, from July '52) are still available; no charge for single copies.

● The articles are excellent and deserve a prominent position in any engineer's library.

D. D. DAVIDSON
Chief Engineer
Golden Bear Oil Co.
Los Angeles, Calif.

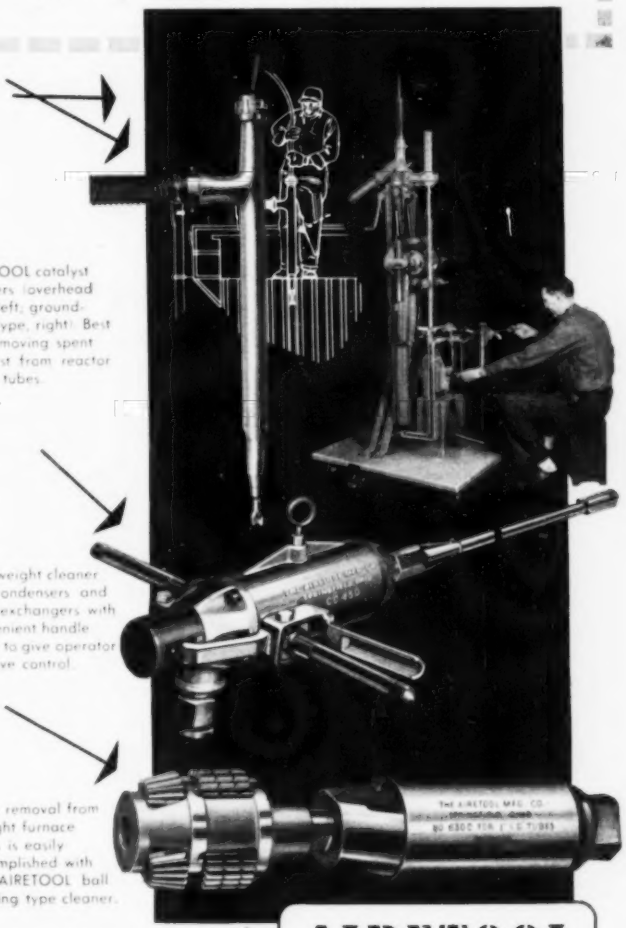
● As far as I know, the series is the first of its kind and a novelty that will be appreciated by your advertisers and many readers. It is a clever idea.

WILLIAM F. LOWE
Secretary
Natural Gasoline Assn. of America
Tulsa, Okla.

PRODUCTIVE refineries depend on AIRETOOL tube cleaners!

It's a fact that America's foremost refineries—refineries that insist on the most efficient equipment available—overwhelmingly favor AIRETOOL tube cleaners. Below are listed just a few of the many available for tough tube cleaning jobs.

Write The AIRETOOL Mfg. Co., 536 S. Center St., Springfield, Ohio, for complete details.



AIRETOOL catalyst cleaners (overhead type, left; ground-level type, right). Best for removing spent catalyst from reactor tower tubes.

Lightweight cleaner for condensers and heat exchangers with convenient handle valve to give operator positive control.

Coke removal from straight furnace tubes is easily accomplished with this AIRETOOL ball bearing type cleaner.

SEE OUR CATALOG IN THE REFINERY CATALOG

BRANCH OFFICES: New York, Philadelphia, Chicago, Tulsa, Baton Rouge, Houston
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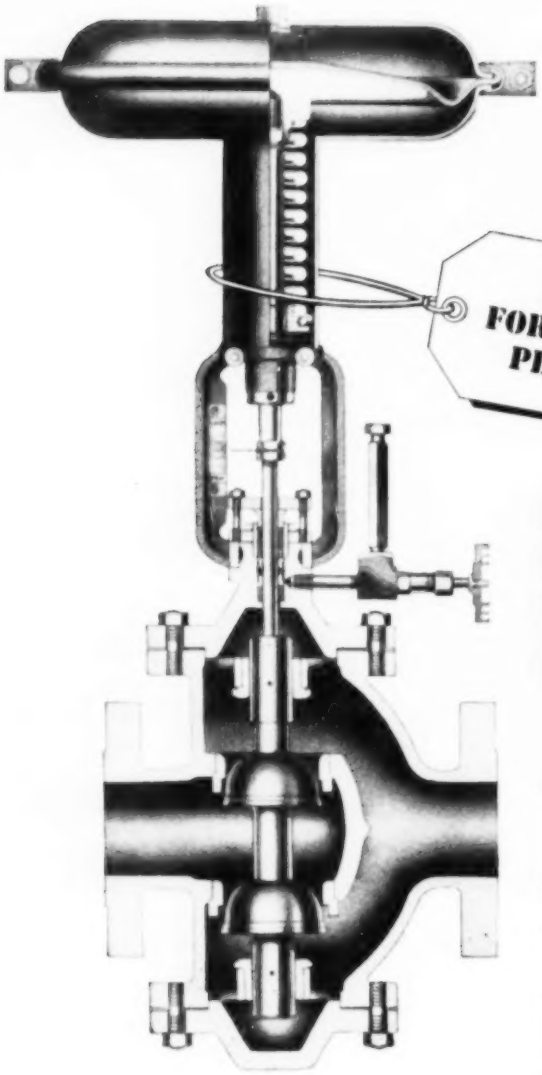
There's an AIRETOOL Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

(To obtain more data on advertised products see page 1344)



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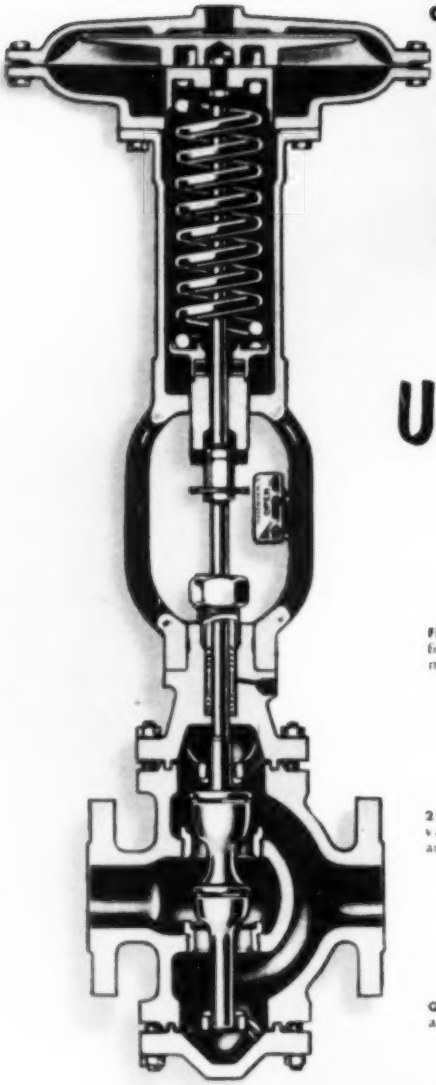

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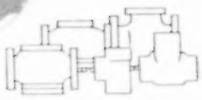

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QUALITY CONTROLLED materials and workmanship.

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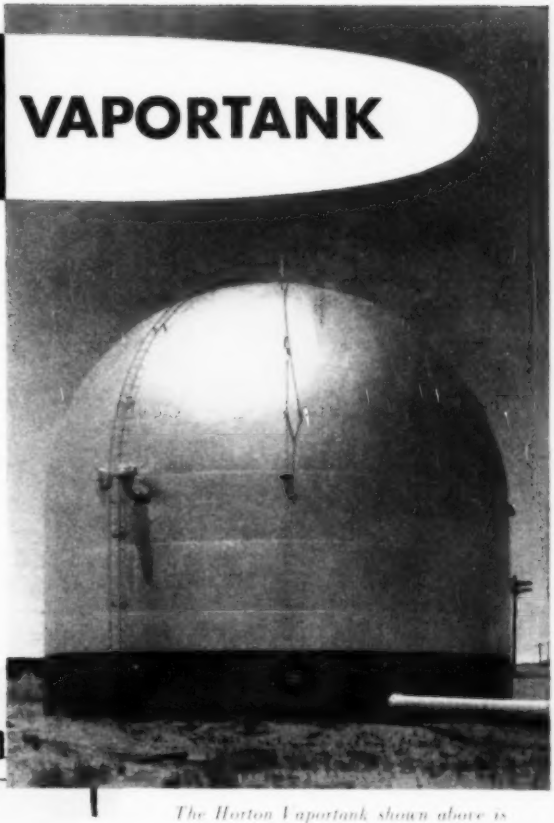

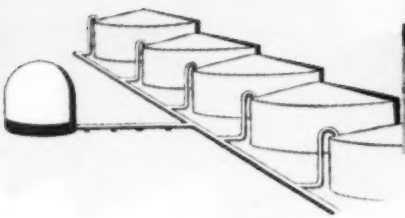

The Horton Vaportank shown above is one of two at the Cosden Petroleum Company's plant at Big Spring, Texas. It has a capacity of 50,000 cu. ft. and the other one holds 150,000 cu. ft.

The Horton Vaportank consists primarily of a cylindrical shell with a hemispherical top and flat bottom. Inside is a flexible membrane, the outer edge of which is attached to the top of the straight portion of the shell. A vent allows air to flow in and out of the space above the flexible membrane. The space below the membrane is connected to the vapor spaces of several cone roof tanks by light-weight, large-diameter vapor piping.

When the atmospheric temperature rises and the air-vapor mixture in the interconnected fixed roof tanks expands the extra volume of vapor flows into the Horton Vaportank. The flexible membrane is lifted into the dome to make room for the incoming air-vapor mixture.

When the temperature drops and the air-vapor mixture in the tank contracts, the vapor in the Vaportank flows back into the storage tanks and the flexible membrane returns to the original position. Thus no valuable air-vapor mixtures escape. The savings are evident.

Other Horton structures designed for use in vapor saving systems, and that incorporate the same principle of a flexible membrane, are the Horton Vapor-sphere and the Hortondome Roof.

More complete information may be obtained by writing our nearest office. There is no obligation.

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Houston 2 — 2135 C&I Life Building
Los Angeles 17 — 1526 General Petroleum Building
New York 6 — 3330—165 Broadway Building
Philadelphia 2 — 1620—1700 Walnut St. Building
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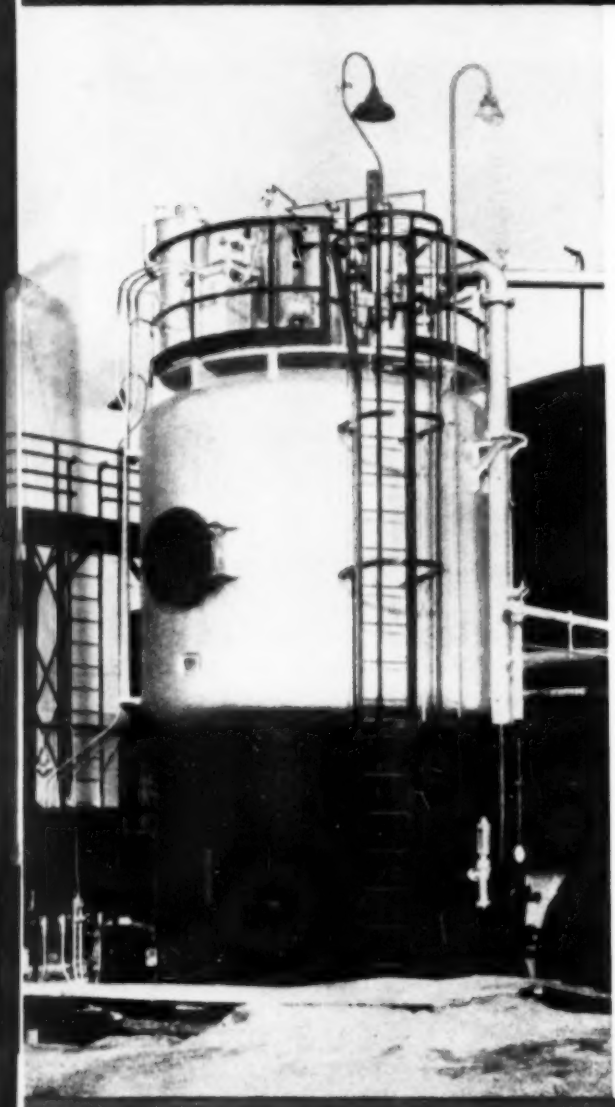


The new Petreco Electric Process takes the guesswork out of distillate treating. It is applicable to acid, alkali or doctor treating of distillate stocks such as naphtha, gasoline, kerosine, cat cracker charges, cat cycle oils, diesel fuel and furnace oil.

The Petreco Electric Process provides continuous, automatically controlled treating *with predictable results.* It utilizes less equipment, occupies minimum ground space, requires fewer pumps, less operating attention and eliminates the need for mechanical separating devices. Processing is in a closed system; no fumes or air pollutants can escape. Except for the few pumps required, there are no moving parts. Because the treating operation is automatically controlled with precision devices, the treating agent (acid, caustic, doctor) requirements are generally less per barrel of oil treated than those of conventional systems. As indicated in the flow diagram, treating for a one-phase system is carried on in a comparatively small, self-contained vessel. Multiple stage systems of any given capacity can be designed to suit refinery requirements.

In refinery use the Petreco Electric Distillate Treating Process has shown substantial savings in treating agent usage alone. In addition, considerable savings are to be gained in power usage as well as in operating and maintenance time.

PETRECO

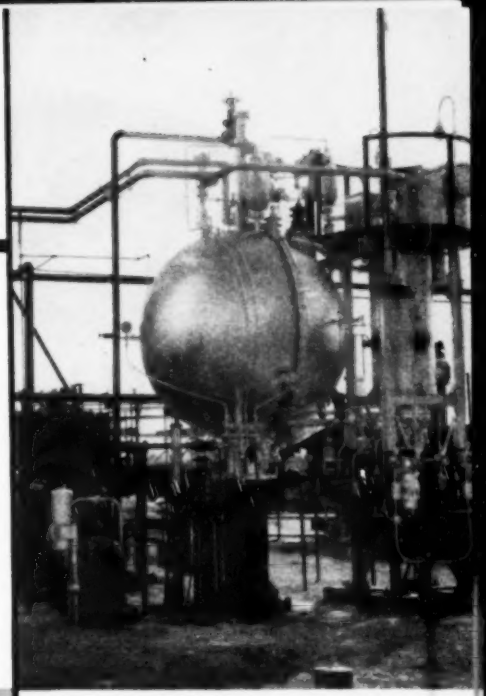
ELECTRIC PROCESSES FOR THE PURIFICATION OF PETROLEUM

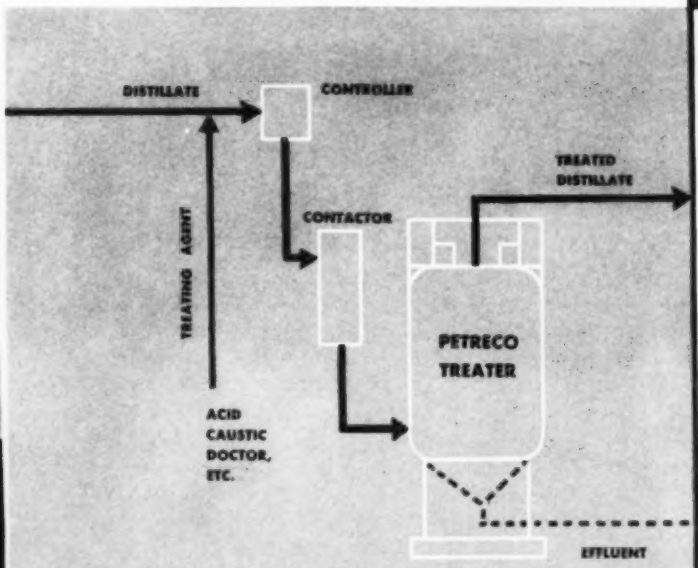
PETRECO

ELECTRIC PROCESS

for

DISTILLATE TREATING





Flow diagram of typical, single-stage Petreco Electric Distillate Treating Process

Advantages

COMPACT — requires minimum space, minimum equipment.

ECONOMICAL — uses less treating agent, gives higher product yield.

AUTOMATIC — injection, contacting and separation are automatically precision-controlled.

RELIABLE — the automatic, precision-control assures definite, predictable results.

EFFICIENT — treated distillate is free of pepper-sludge, caustic, doctor solution.

POSITIVE — assures a quick break and complete separation. Amount of acid-sludge is reduced and is more suitable for re-use or recovery, emulsion in caustic effluent is eliminated, no black-strap is formed in doctor treating.

NON-POLLUTING — the system is entirely closed. There is no chance for irritating fumes to escape.

COMPLETE — water washing is eliminated, except in some unusual cases.

EASILY MAINTAINED —the closed system, with no moving parts, stays clean, does not break down.

Petrolite Corporation—PETRECO DIVISION

3202 SO. WAYSIDE DRIVE, HOUSTON 1, TEXAS

1390 E. BURNETT STREET, LONG BEACH 6, CALIFORNIA

CRUDE OIL: REMOVAL OF SALTS, SOLIDS AND OTHER IMPURITIES; DEHYDRATING
DISTILLATES: ACID, CAUSTIC AND DOCTOR TREATING
FUEL STOCKS: DESAPONIFICATION

PS 52-5

Investigate the many savings and advantages to be gained from this revolutionary new method of distillate treating. Complete information is available on request.

Get it now!

Make the Call...

Petroleum refining and chemical manufacturing are industries of almost incredible operations. They have spent for new facilities since 1947 a sum roughly equal to total gross plant investment for all processes. In these accomplishments, The Lummus Company—as design engineers and constructors—was privileged to play a major role.

But the years ahead are apt to make the past look puny by comparison. This year, for example, oil companies will top 1951 capital spending by over a third; chemical companies by nearly a fifth. Preliminary plans through 1955 show little or no relaxation from this rate.

Big job? Lummus is ready—a fact you may wish to bear in mind as mounting demands challenge the already extended organizations of petroleum and chemical companies.

Rely on the quality and versatility of the Lummus staff—on the proven ability of Lummus to handle, under one contract, the functions of engineering, drafting, purchasing, expediting, inspecting, erection and initial operation.

And—as a policy statement for the record—rely on us to recognize and accept the special responsibility of handling confidential information in accordance with your own best interests and desires.

May we work together? We're ready!

THE LUMMUS COMPANY

385 MADISON AVENUE, NEW YORK 17, N. Y.

HOUSTON • CHICAGO • LONDON • PARIS • CARACAS

DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

Reduce Fouling in your plant

with **BROWN FINTUBE** *sectional hairpin heat exchangers*

● Brown Sectional Heat Exchangers, with their integral one-piece extended surface fintubes, reduce fouling, just a few hundredths of an inch of which on a tube causes a major loss in heat transfer efficiency.

These exchangers assure efficient operation at low "skin" temperatures, minimizing coking and building up on the fintubes. And the controlled flow through the longitudinal passages keeps all the material in continuous motion. There are no baffles, back-eddies or stagnant areas to encourage fouling.

For top operating efficiency and reduced fouling use Brown Sectional Heat Exchangers throughout your plant. ***Write for Bulletin No. 512***

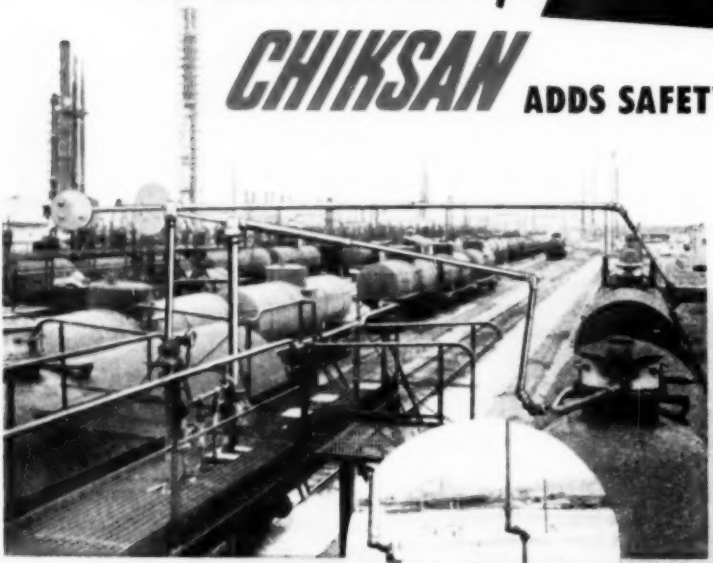
THE BROWN FINTUBE CO.
Elyria, Ohio

Sectional Hairpin Heat Exchangers
Tank Suction and Line Heaters
Fintube Heaters for Bulk Storage Tanks
Indirect Process Air Heaters
Fintube Heaters for Processing Tanks
Integrally Welded Fintubes for Any Heating, Cooling or Heat Transfer Service

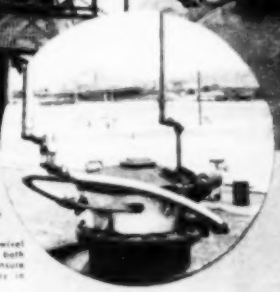
NEW YORK • BOSTON • PHILADELPHIA • WILMINGTON • PITTSBURGH • BUFFALO • CLEVELAND • CINCINNATI • DETROIT • CHICAGO
ST. PAUL • ST. LOUIS • MEMPHIS • BIRMINGHAM • NEW ORLEANS • TULSA • HOUSTON • LOS ANGELES • SAN FRANCISCO

When Butane says "HANDLE WITH CARE"

CHIKSAN ADDS SAFETY and SPEED TO LOADING OF TANK CAR AND TRUCK



With counterbalanced Chiksan loading racks, one man can quickly and easily make connections to tank cars.



CHIKSAN low pressure swivel joints employed here on both supply and return lines insure safety, speed and economy in loading tank cars.

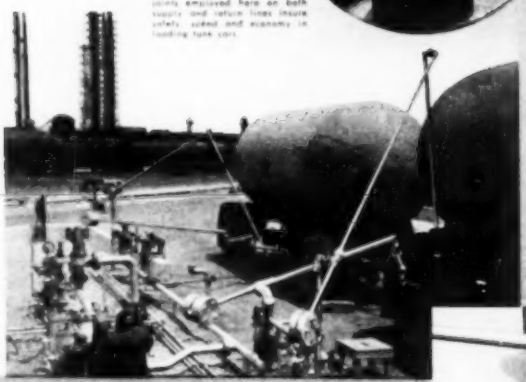
It takes speed, safety and kid-glove handling to keep up the massive flow of liquefied petroleum gas at Standard Oil Company of California's El Segundo plant.

Chiksan provides the necessary liquid-tight, gas-tight unions, the characteristic flexibility of motion to keep the touchy Butane flowing at a swift, even pace with safety to workers, plant and community – with profit to the company.

No less than eight Chiksan Ball-Bearing Swivel Joints are needed for each loading installation to keep the gas moving into tank and truck—to provide the essential carry-off of the highly explosive vapors. And with Chiksan on the job, metal of relative low porosity takes the place of more porous and less safe rubber.

Standard Oil Company of California's El Segundo installations are typical of industry's reliance on Chiksan Ball-Bearing Swivel Joints around the world to speed the flow of enterprise – to promote production and defense – to increase safety – to protect profits.

Wherever liquid or gas must flow in industry – wherever hydraulic systems can add efficiency and economy – Chiksan Ball-Bearing Swivel Joints are on the job. If more flexibility – greater stamina – longer life and added economy are of interest to you, Chiksan's Research and Development Division can help you find a better, swifter way.



A typical near ground level truck loading rack using CHIKSAN joints on supply and return lines.

Close up of CHIKSAN low pressure joints on supply and return lines of truck loading of Butane.

The Flow of Enterprise Rides on **CHIKSAN** *Ball-Bearing Swivel Joints*

Representatives in Principal Cities Write for Catalog 51-C, Dept. 0000

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 28, Illinois • Newark 2, New Jersey

Weil Equipment Mfg. Corp. (Division), Houston 1, Texas • Chiksan Export Company (Subsidiary), Brea, California; Newark 2, N. J.

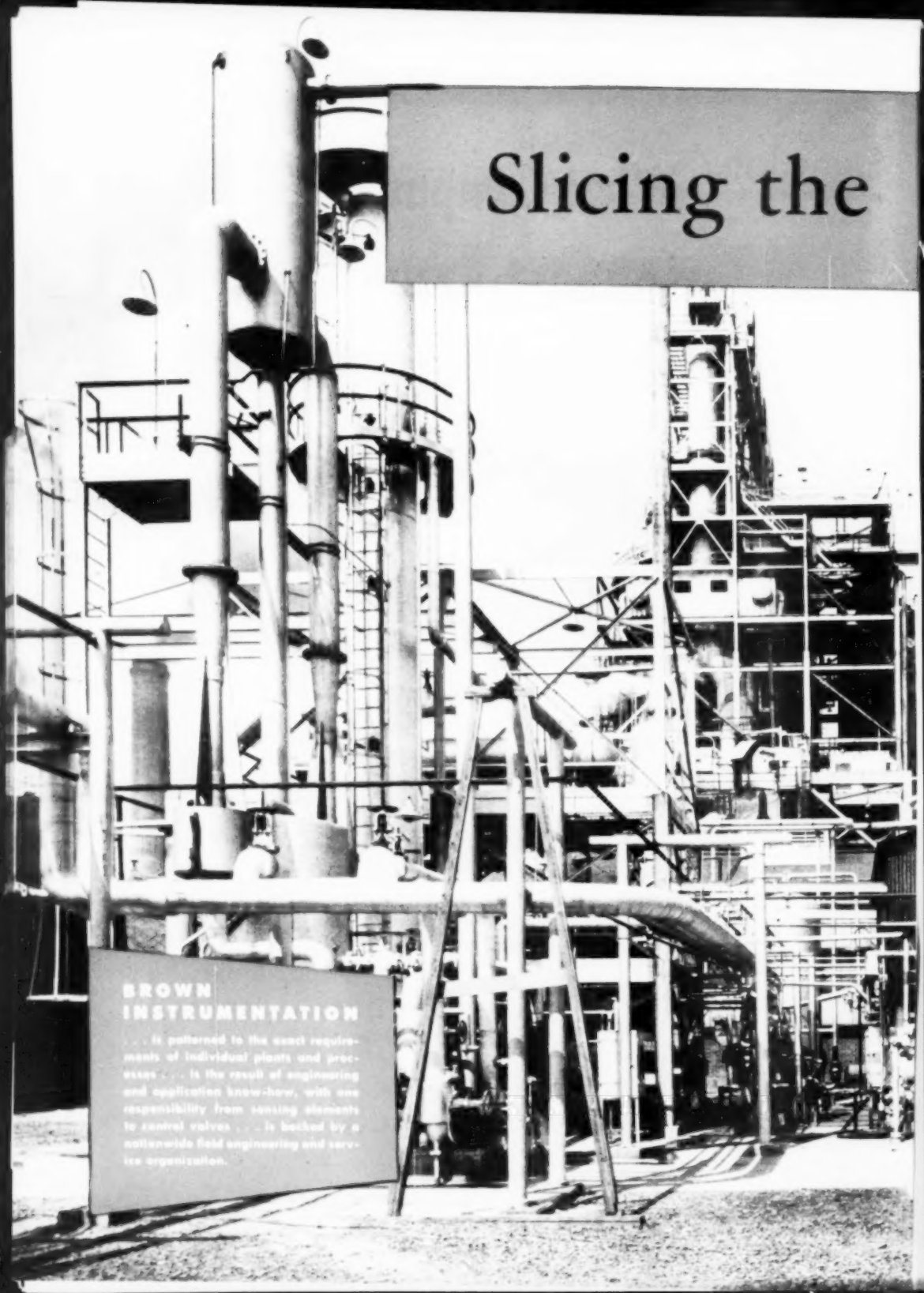
Question: **What Company Has the Longest Experience in Making Tetraethyl Lead Antiknock Compound?**

Answer: Du Pont was the pioneer and only producer of TEL Antiknock Compound from 1923 to September 1945. In fact, it was Du Pont who developed the first safe process for manufacturing tetraethyl lead on a commercial scale.

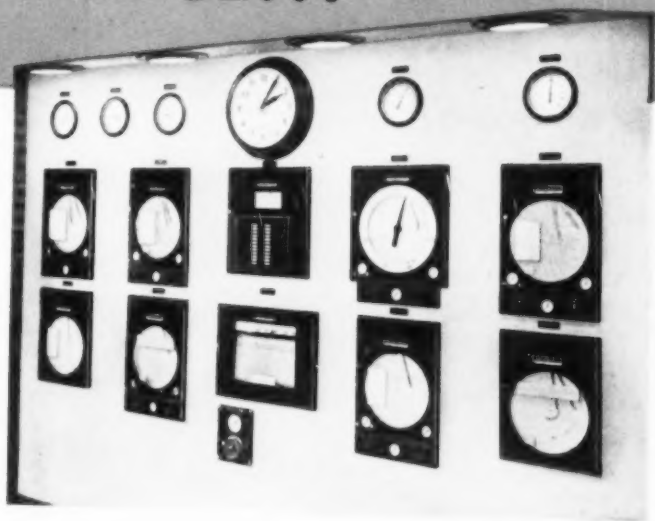
Recently, Du Pont perfected a complete new manufacturing unit for making tetraethyl lead. This development will speed the production of TEL and make more of it available for refiners. The new unit is another example of Du Pont's pace-setting research and development activities on behalf of the petroleum industry. Ask your Du Pont representative for the many other services available to you.

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & CO. (INC.) • Petroleum Chemicals Division, Wilmington 98, Delaware


Slicing the
BROWN
INSTRUMENTATION
. . . is patterned to the exact requirements of individual plants and processes . . . is the result of engineering and application know-how, with one responsibility from sensing elements to control valves . . . is backed by a nationwide field engineering and service organization.

cuts thinner...



Deethanizing unit for fractionation of liquefied petroleum gas at Sinclair Refining Co. is regulated by Brown Instruments (at right) on factory-assembled panelboard.

with the help of
Brown Advanced Instrumentation

ACCURATE, coordinated control of fractionation is proving the key to economical separation and purification of chemicals, and to the efficient recovery of light ends of petroleum for conversion to liquid petroleum gas and petrochemicals.

Typical of modern fractionation is the LPG plant of the Sinclair Refining Company at Marcus Hook, Pa. Here as in thousands of operations throughout the world, Brown Instruments measure, record and control every variable critical to process efficiency . . . holding each in line with the precision essential to top output and quality.

When you're looking for automatic recording and controlling instruments for your fractionating operation, or *any other process, consider first:*

- The Brown know-how developed through many years of application experience in the industry.
- The completeness of the Brown line—recorders, controllers, panelboards, valves and accessories.

For a detailed discussion of your process requirements, call in our local engineering representative . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4502 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

First in Controls

● *Important Reference Data*

Write for Composite Catalog No. 5000 describing the principal Honeywell instruments for process industries

The fittings that revolutionized pipe welding . . .

In the year 1931 Taylor Forge gave industry its *first real line* of seamless, butt-welding pipe fittings. We say it was the first *real* line because it was the first to include not only long and short radius ells, but also full branch and reducing tees, concentric and eccentric reducers, stub ends, caps and welding neck flanges.

This was a fully planned development. Many years before Taylor Forge had foreseen the future of the butt-welding fitting . . . had realized that pipe welding could not go beyond its then crude stage until pipe users were given *all* the fittings necessary to make up complete piping systems.

So Taylor Forge went to work on this and after long research and development came out with the full line that became the inspiration of modern pipe welding.

Naturally the organization that started ahead has kept ahead . . . in design, in quality, in breadth of line. That is why so many men who have followed the development of the WeldELL line, refuse to consider any other kind of welding fittings.

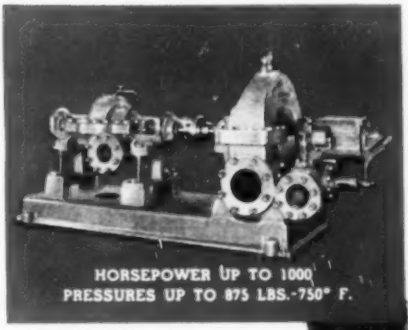
TF

For up-to-the-minute facts, see your Taylor Forge distributor

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
Offices in all principal cities. Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Designed with the operator in mind!

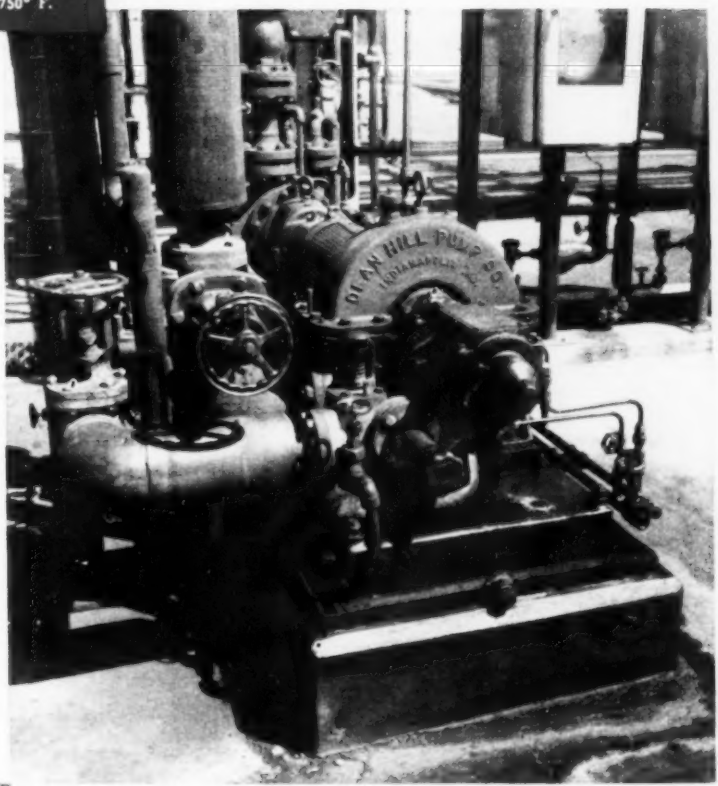


HORSEPOWER UP TO 1000
PRESSURES UP TO 875 LBS.-750° F.

No streamline housings.
No needless cover-ups.
Nothing fancy or frilly about these power-making huskies. Dean Hill Steam Turbines are designed and built for nothing but long service and easy, economical operation. Their heavy, rugged construction is simple and uncluttered for quick, easy maintenance. All pressure parts are outside and visible to operator.

DEAN HILL STEAM TURBINES

... are single stage, double impact type for low steam consumption. Specifically designed for operation at medium steam pressures and temperatures, DH Turbines have all the advantages available under these conditions, including excellent water rates. Write us for further information and complete specifications.



One of eighty-four Dean Hill Steam Turbines recently installed in a large, eastern Refinery

DEAN HILL PUMP COMPANY

Pump and Turbine Engineers Since 1895

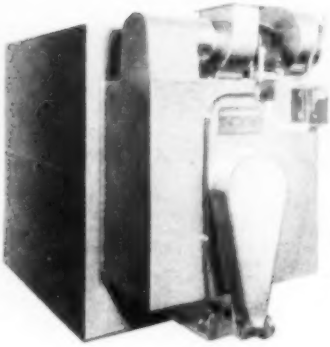
INDIANAPOLIS 7, INDIANA

SALES OFFICES IN:

Chicago • Mexico City • Philadelphia • Salt Lake City • New York • Dallas • New Orleans • San Francisco • Denver • Los Angeles • Pittsburgh • Houston • St. Paul • Cleveland

Put your storage tanks on a DRY air diet with Lectrobreathers*

The moist air they're inhaling wastes money and destroys quality



A tank breathes freely, as air passes through the charge of Activated Alumina and is dried DRY. When a Lectrobreather needs reactivation, it is lifted off and a spare takes its place.

Where volumes of air passing in and out of a storage tank are sufficient, a Lectrodryer* is used. Since its DRYing-reactivating cycle can be reversed as required, it stays right on the job.

A processor was buying certain liquids in drums, *at premium prices*, because the moisture in the air the storage tanks inhaled injured their quality. Then he discovered Lectrobreathers, which feed only DRY air to the tanks. Now he buys in tank-car lots, saving on raw materials, saving on handling and holding quality constant.

An oil company safeguards its fine lubricating oils against contamination by water from the time it is refined until it is safely packaged. They hold a blanket of DRY air over the oil by forcing the tanks to breathe through Lectrodryers that remove every trace of moisture from the air.

Lectrobreathers and Lectrodryers will make certain that any tank, little or big, breathes only DRY air. Which to use is determined by the size of the DRYing task. A Lectrobreather has a color indicator which tells when it should be reactivated. Operation of a Lectrodryer can be made fully automatic.

For help in selecting and applying the DRYing equipment you need, tell your problem to Pittsburgh Lectrodryer Corporation, 332 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sydney
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege

LECTRODRYERS DRY
WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U. S. PAT. OFF.

YOU'LL FIND TRECO CATS FROM BORDER TO BORDER

- Hi-Way Refineries, Ltd., Saskatoon, Saskatchewan, Canada
- Farmers Union Central Exchange, Laurel, Montana
- Cooperative Refinery Association, Phillipsburg, Kansas
- National Cooperative Refinery Association, McPherson, Kansas
- Kanotex Refining Company, Arkansas City, Kansas
- El Dorado Refining Company, El Dorado, Kansas
- Midland Cooperative Wholesale, Cushing, Oklahoma
- Cosden Petroleum Corporation, Big Spring, Texas
- McMurrey Refining Company, Tyler, Texas
- Southwestern Oil and Refining Company, Corpus Christi, Texas

After only ten years in business, **REFINERY ENGINEERING** Company has built cat crackers from border to border—from Canada to Mexico and has seven under construction at this time.

If your company is considering a new cat cracker or other new refining facilities or the revamping of your old plant, it will pay you to confer with Treco at once. A call from you will be appreciated and will receive prompt, courteous attention.

We have just produced a brochure telling the story of Treco and showing many of the jobs we have completed. A copy will be mailed you promptly if requested on your company letterhead.

THIS YOUNG TUBE-AND-FIN
CORE PAYS A BONUS!
● PERMANENT, PERFECT BOND BETWEEN TUBES AND FINS
● GREATER HEAT TRANSFER EFFICIENCY
This die-formed collar provides a tight, permanent bond along entire length of tube as shown in cross section at left.

Here's why Young-designed and built tube and plate fin cores give greater heat transfer efficiency . . . stand up better under peak capacity operation . . . pay bigger dividends in longer trouble-free service. The outstanding design and construction of the Young plate type fin core, shown above, features specially die-formed reinforced collars which make a continuous, permanent bond between fins and tubes . . . providing maximum heat transfer and greatly stronger, longer-lasting cores.

This mechanical structure of greater strength which permits the use of the most desirable metals chosen for the job — copper, aluminum or other alloys — is attributable to Young's precision-manufactured, high-quality cores.

Whatever your need, consult your nearest Young Sales Representative to help you select correct cores — types and sizes — and discuss any phase of your heat transfer problems.

One of our many important installations is the Reynolds Metals Company's new San Patricio, Texas plant which uses more than 80 Young units featuring the new "bonus" core for cooling engine jacket water and lube oil, and 91 additional units of Young variated, specially designed construction.

25 YEARS OF PROGRESS

YOUNG

Heat Transfer Products for Automotive and Industrial Applications.

Heating, Cooling, Air Conditioning Products for Home and Industry.

YOUNG RADIATOR COMPANY

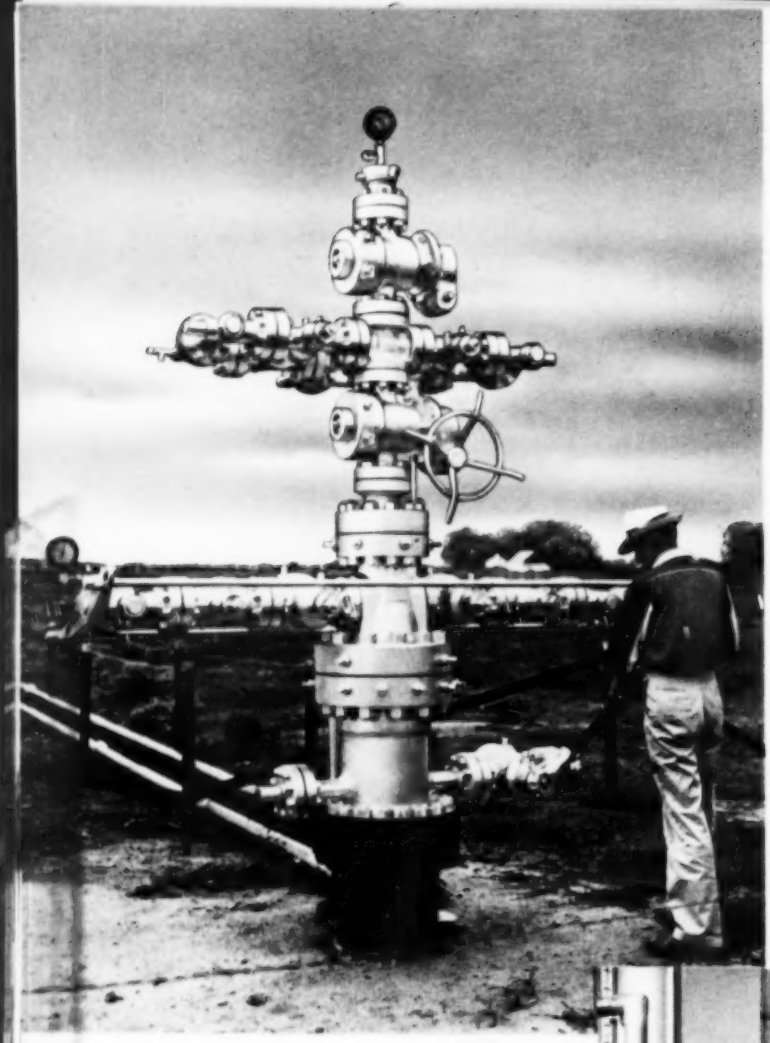
OUR FIELD REPRESENTATIVES:
TULSA — E. K. Nock Company, 1341 S. Boston St., Rm. 109
LOS ANGELES: Hamilton & Everett, Inc., 5043 Santa Fe Ave.
MUSKEGON: Harold T. Young, 206 Montgomery Bldg.
Other Representatives in Principal Cities

Plant Protection, A MILLION TIMES OVER

More than five million Nordstrom valves have been installed in gas, petroleum, chemical and other industrial flow lines. Each one is a little additional insurance, an extra unit of plant protection.
The record is their best reference.

Rockwell Another Rockwell Product **Built**
Nordstrom Valves

LUBRICANT SEALED TO KEEP UPKEEP DOWN



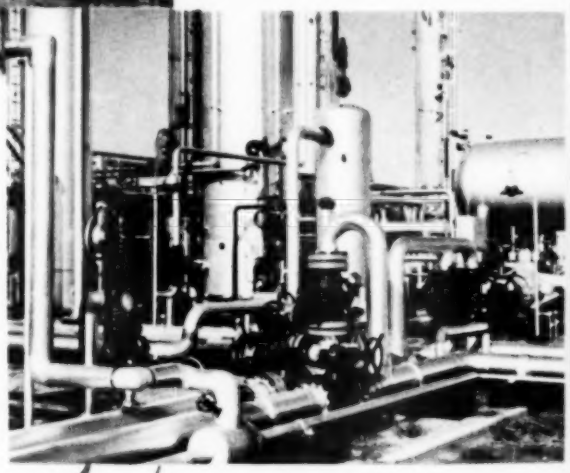
You'll Find Nordstrom Valves ANYWHERE... *Everywhere*

FIELD SERVICES

New design Christmas tree in Louisiana oil fields, built with Nordstrom 5,000 lb Hypreseal valves, is typical of Nordstrom field applications. This dual completion tree stands on well, producing from two depths.

PROCESS LINES

In a single process plant you'll likely find a dozen different types of Nordstrom valves. There is a proper Nordstrom valve for nearly any process service. Nordstrom valves in lines shown here are teamed with Rockwell-built Edward forged steel valves.



Rockwell Built
Another Rockwell Product
Nordstrom Valves

Anywhere.... **EVERYWHERE**

In gas, petroleum, chemical and general industrial service . . . there's a Nordstrom Valve to do the job.
Rockwell Manufacturing Company,
400 N. Lexington Ave., Pittsburgh 8, Pa.

Freedom to Sell is Vital to as All

Eight decades ago 70% of all gainful workers in the U. S. A. toiled in agriculture. Today farms and factories, put together, account for less than 40%.

Where do the rest serve? Chiefly in distribution, which includes the physical movement of products to buyers, and all forms of selling, advertising and sales promotion at the manufacturing, wholesale and retail levels, as well as the widely varied services related to the maintenance and use of American products.

With over 60% of our total labor force falling outside of farm and factory employment, obviously salesmen on the front line of selling contribute greatly to the productivity, prosperity and the world's highest standard of living enjoyed by the U. S. A.

Without sales a business fails and jobs vanish. No matter how good a product may be, it must be sold in competition with other goods. A salesman sometimes finds his products not truly competitive. He then exercises tremendous pressures on his employer for better products, lower prices, or both. Thus, competitive selling greatly influences the progress of American prosperity.

Countries where selling is inefficient, restricted or eliminated generate far less wealth, happiness and security.

Competition, especially competitive selling, is a great American Freedom. Let us preserve it to assure Progress For All Our People.

• • •

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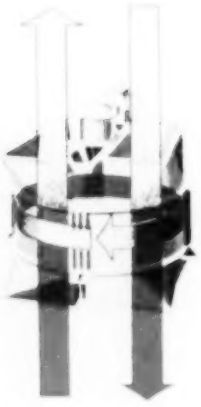
THE COMPETITIVE SYSTEM DELIVERS THE MOST TO THE GREATEST NUMBER OF PEOPLE

Replace Still Convection Surfaces...

...with a Ljungstrom Air Preheater



The Ljungstrom operates on the continuous regenerative counter-flow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

In purchasing new equipment—or modernizing existing equipment—one way to save impressive amounts of capital as well as operating expense is to design for a Ljungstrom Air Preheater.

Because the Ljungstrom promotes such greatly increased heat liberation in the furnace, the convection bank of oil tubes can generally be eliminated from the design. This can in itself *more than pay the cost of the Ljungstrom installation.*

Add to this the proved fuel savings . . . the higher product quality . . . greater throughput possible with a Ljungstrom—and you will see why the Ljungstrom is an eminently practical piece of equipment to be considered wherever fuel is burned.

In these days of high fuel costs and skyrocketing demands for petroleum products, every refinery should consider a Ljungstrom whenever equipment is being purchased or modernized. Call or write The Air Preheater Corporation for complete details.

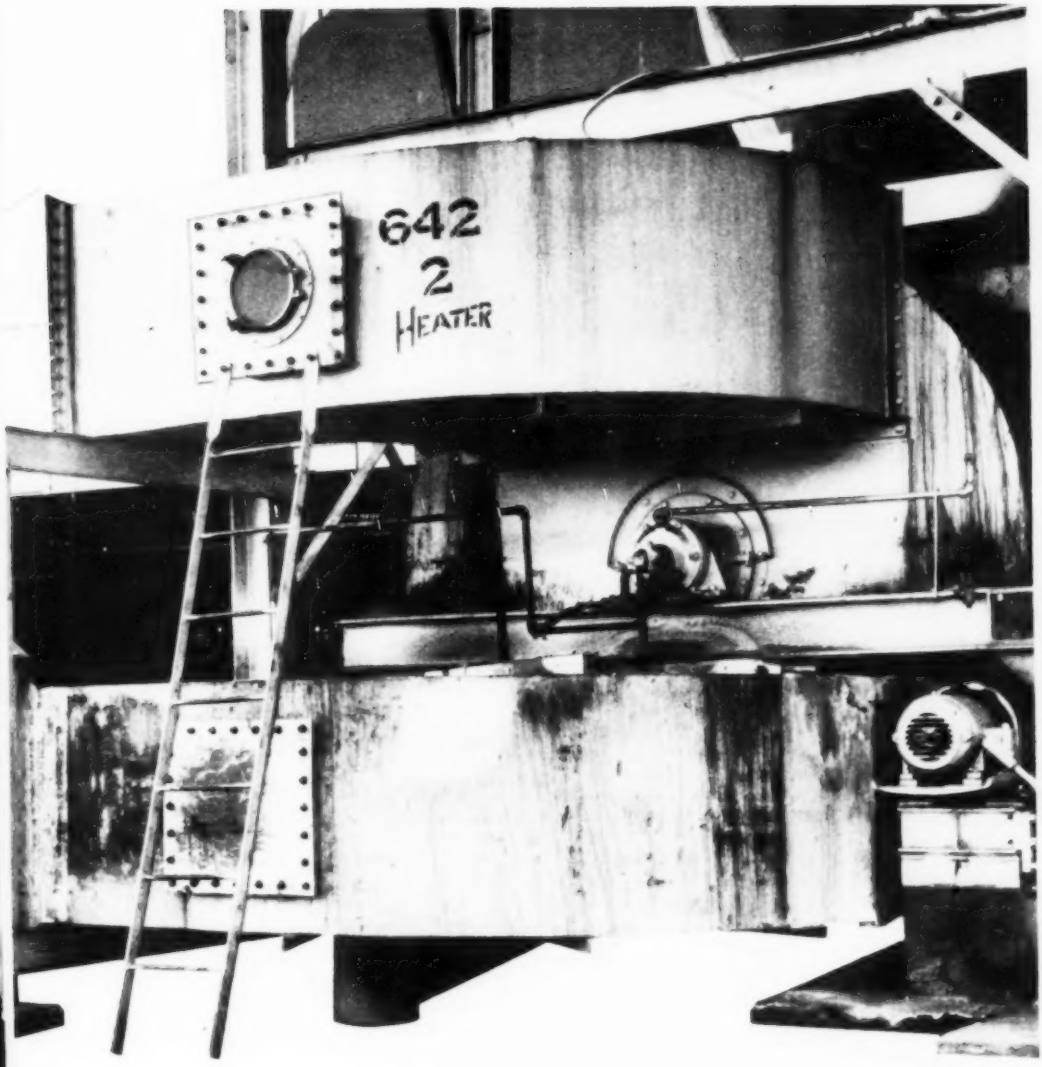
Wherever You Burn Fuel, You Need Ljungstrom

Refineries Now Using the Ljungstrom Air Preheater on One or More Process Units

Continental Oil Company
Interocean Oil Company
La Consellia Nacional de Petroleo Ref.
Lion Oil Company • Ohio Oil Company
Richfield Oil Corporation
Sinclair Refining Company
Socony Vacuum Oil Company
Standard Oil Company of California
Standard Oil Company of New Jersey

The Ljungstrom is no stranger to refineries. For years it has been a standard item for utilizing waste heat from power and process steam boilers. These refiners now use Ljungstrom Air Preheaters on steam boilers . . .

Cit-Con Oil Corporation • Continental Oil Corporation
Esso Standard Oil Company • Humble Oil & Refining Company
Magnolia Petroleum Corporation • Pan American Refining Company
Phillips Petroleum Company • Shell Oil Company
Standard Oil Company of Indiana
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey • The Pure Oil Company
The Texas Company • Tidewater Associated Oil Company
Wilshire Oil Company



Consider Ljungstrom Air Preheaters for . . .

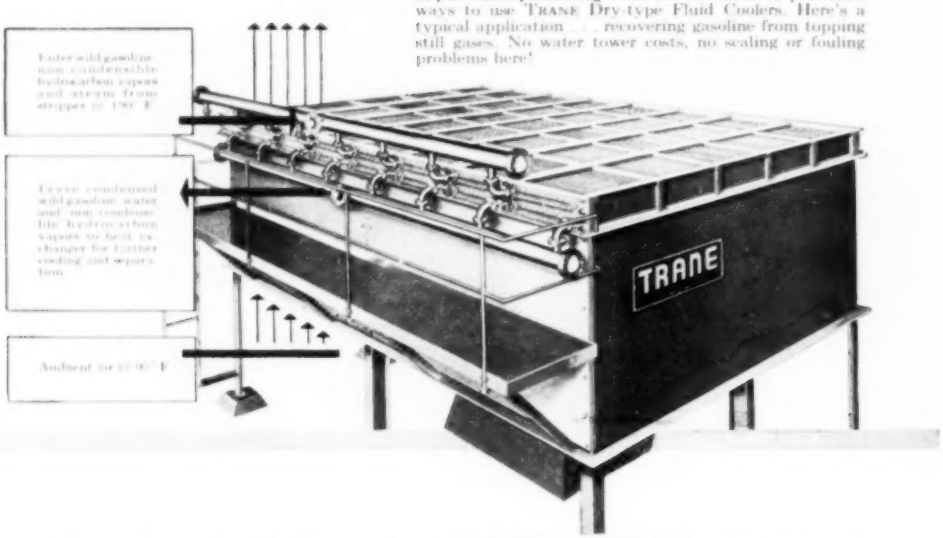
Catalytic Cracking
Coking
Petrochemical Production
Petrochemical Separation
Petrochemical Synthesis
Polyforming
Propane Deasphalting
Reforming
Solvent Refining
Thermal Cracking
Visbreaking

THE AIR PREHEATER CORPORATION
60 East 42nd Street, New York 17, N. Y.

Here's how petroleum processors can cool with air... cut water costs

WITH TRANE DRY-TYPE FLUID COOLERS

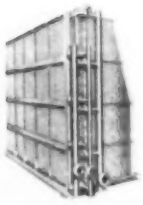
In petroleum processing there are hundreds of profitable ways to use TRANE Dry-type Fluid Coolers. Here's a typical application . . . recovering gasoline from topping still gases. No water tower costs, no scaling or fouling problems here!


Enter wild gasoline, non-condensible hydrocarbon vapors and steam from stripper at 190° F.
Leave condensed wild gasoline, water and non-condensible hydrocarbon vapors to heat exchanger for further cooling and separation.
Ambient air @ 90° F.
TRANE

In areas where water is in short supply, and where conditions of heavy fouling and scaling are prevalent, petroleum engineers are discovering that TRANE Dry-type Fluid Coolers solve many of their problems.

There are many sizes of TRANE Dry-type Fluid Coolers. Each is engineered to the job. *Consider these advantages . . .*

1. **NO WATER PROBLEMS:** closed system prevents fouling of water or other fluid.
2. **HUNDREDS OF APPLICATIONS:** applications are limited only by temperature ranges of air cooling and consistencies of fluids to be cooled.
3. **LOW-COST MAINTENANCE:** easier cleaning through removable headers. Fewer shutdowns.
4. **EASY WINTER MAINTENANCE,** compared to cooling towers, because TRANE Fluid Coolers use only air.
5. **HIGH TEMPERATURE CAPACITIES,** limited only by workability of high temperature alloys.



Wide Range of Sizes TRANE Fluid Coolers are available in two models. The larger or vertical discharge model—Series GC—is made in 6 regular sizes with fan diameters ranging from 72" to 144". The smaller or horizontal discharge model—Series EC—comes in 14 sizes with fan diameters ranging from 18" to 120".

Left—TRANE Series EC Fluid Cooler. Main Illustration Above—TRANE Series GC Fluid Cooler.

TRANE

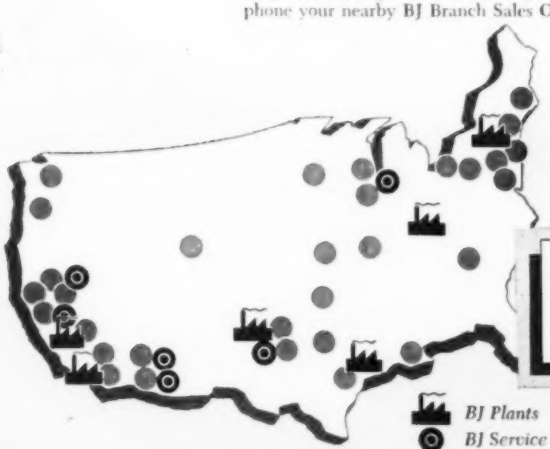
THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division, Scranton, Pa.
Trane Company of Canada, Ltd., . . . Toronto
Offices in 80 U.S. and 14 Canadian Cities

MANUFACTURING ENGINEERS OF HEATING, VENTILATING, AIR CONDITIONING AND HEAT TRANSFER EQUIPMENT

Is there a pump doctor in the house?

YES... THERE'S A BJ PUMP SPECIALIST A FEW MILES OR MINUTES FROM YOU!

If you have a sick pump—or if you're having trouble diagnosing a pumping problem, a BJ pump specialist can help. These fully-qualified BJ Sales Engineers, working out of 31 *company* sales offices, bring you the benefit of BJ's 80 years' experience in meeting and solving every kind of pumping problem. These local Byron Jackson offices are in addition to BJ's six modern factories, six service shops, and reliable dealers. For pump engineering assistance and quick answers to your particular pumping problems, just phone your nearby BJ Branch Sales Office!



Byron Jackson pump manufacturing plants are located in Los Angeles and Fresno, Calif.; Houston and Plainview, Tex.; Lawrenceburg, Ind.; and Bethlehem, Penn.

In addition, BJ Service Shops are operated in Chicago Heights, Ill.; Chico and Lodi, Calif.; Casa Grande and Phoenix, Ariz., and Lubbock, Tex.

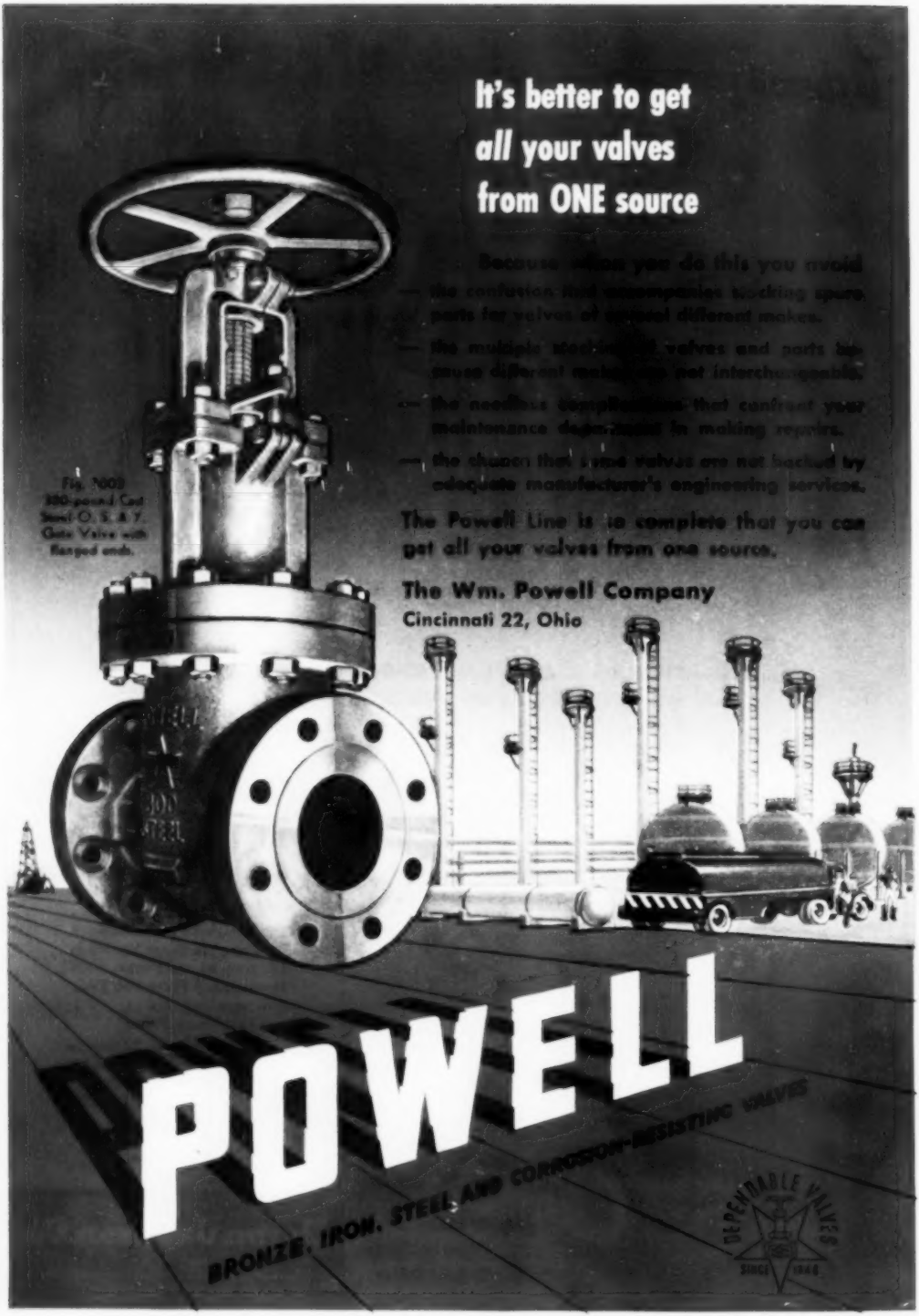
BJ

Byron Jackson Co.

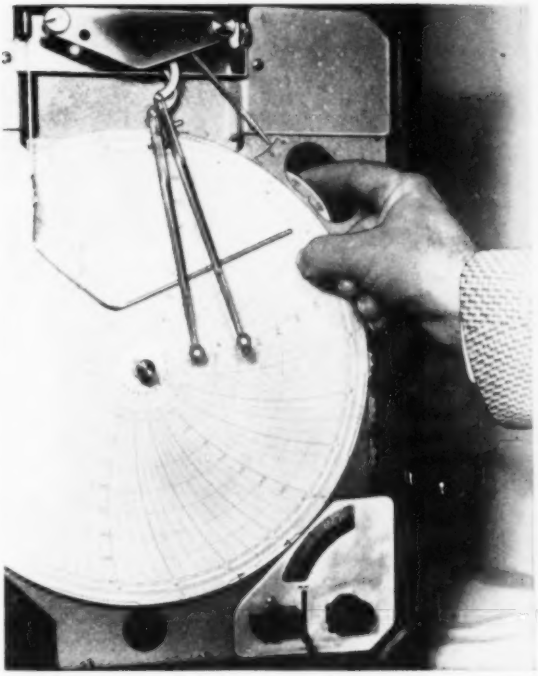
Since 1872

P.O. Box 2017, Terminal Annex, Los Angeles 54, Calif.

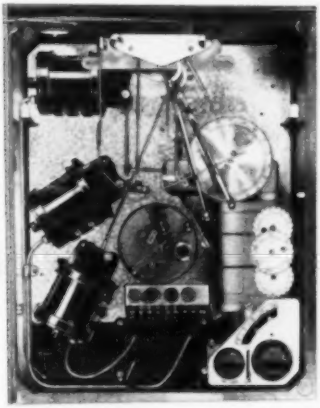
Offices in Principal Cities


It's better to get
all your valves
from ONE source
Because when you do this you avoid
— the confusion and incompetence in stocking spare parts for valves of several different makes.
— the multiple stocking of valves and parts because different makes are not interchangeable.
— the needless complications that confront your maintenance department in making repairs.
— the chance that some valves are not backed by adequate manufacturer's engineering services.
The Powell Line is so complete that you can get all your valves from one source.
The Wm. Powell Company
Cincinnati 22, Ohio
Fig. 7003
300-pound Cast Steel O. S. & Y. Gate Valve with flanged ends.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

NEW
FISCHER & PORTER
automatic
FLOW RATIO CONTROLLER



Compact size with extreme precision of ratio control are important advances in this *new* Fischer & Porter Ratio Controller. Designed specifically for flow ratio control, it makes a perfect combination teamed with the new P-4 Pneumatrol and highly accurate Flowrator meters or variable area cell kinetic manometers, to assure accurate and dependable ratio control of fluids, gases or slurries. Receives pneumatic, electrical, or electronic primary signals. Review the features below, then mail the handy coupon for complete engineering and application data.



Interior view of standard Ratio Controller with pneumatic set ratio adjustment.

The compact stack mounting of the new Ratio Controller atop the P-4 Pneumatrol provides the simplest possible unit. The large ($10\frac{1}{2}$" scale) ratio setting dial permits precise ratio settings which are visible through the door. F & P wide range, linear scale primaries give extreme range of ratio (6:1 to 1:1 to 1:6; a total of 36:1).

CHECK THESE FEATURES:

- Extreme flexibility
- Wide range of ratio
- Based on linear scale primaries
- Control deviation indicator
- Primary element fully corrosion resistant
- Highly visible ratio setting dial
- Extremely compact stack mounting

FLOWRATOR

FISCHER & PORTER COMPANY

1190 COUNTY LINE ROAD, HATBORO, PENNA.

Please send me by return mail complete information on your new Ratio Controller.

NAME _____ POSITION _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

(To obtain more data on advertised products see page 1311)

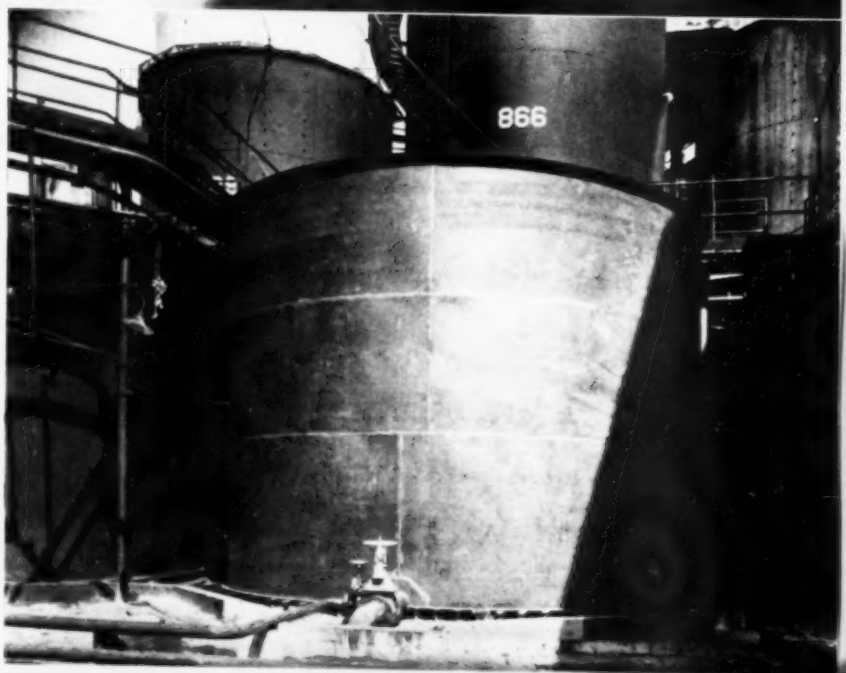
Major Oil Refineries *use*

Inside view of tank showing construction. It was fabricated in three rings with Ampco-Trode electrodes. The top and middle rings are $\frac{3}{16}$ inch Grade 8 Ampco Metal plate. The bottom ring is $\frac{1}{4}$ inch Grade 8 Ampco Metal plate.

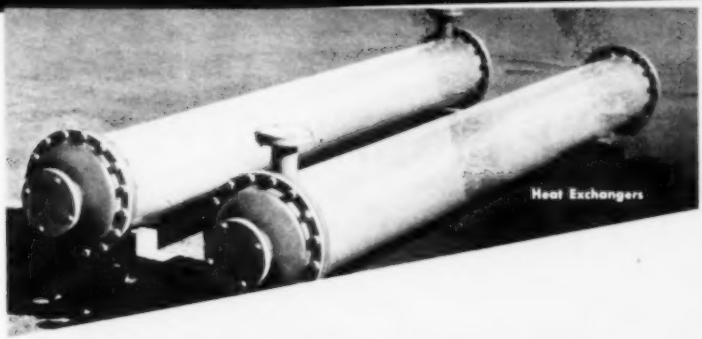
Inner coils are $1\frac{1}{2}$ inch Schedule 80 Grade 8 Ampco Metal Pipe connected with 150 lb. slip-on flanges.

Grade 8 Ampco Metal bolts and Grade 15 Ampco Metal nuts were used throughout.

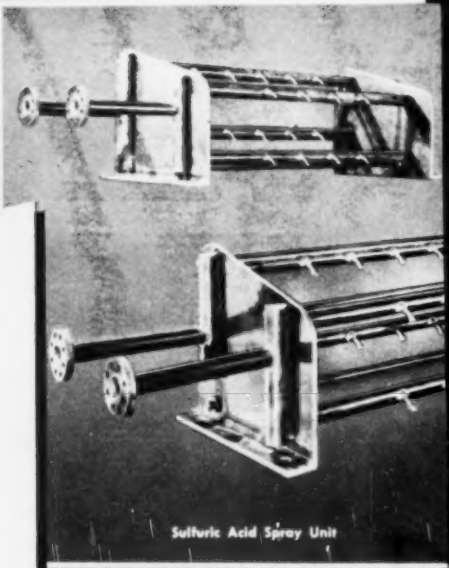
Fabricators: Pacific Coast Engineering Company, Alameda, California.



Ampco Metal sulfuric acid sludge tank in operation at Shell Oil Co.'s Martinez, California plant. Tank is 20 ft. high and 24 ft. in diameter.



Heat Exchangers



Sulfuric Acid Spray Unit

AMPCO* METAL

to hold Sulfuric Acid Sludge

because it RESISTS CORROSION

Yes, Shell Oil Co. and many other refiners and companies in the process industries use Ampco Metal to solve corrosion problems.

Here's why! Ampco Metal Grade 8, one of a series of engineered aluminum bronze alloys, has these unique properties: high resistance to corrosion . . . high tensile strength (75,000 psi) . . . high physicals at extreme temperatures . . . high strength to weight ratio . . . high impact and fatigue values (Charpy @ -423°F., 93 ft. lbs., @ 70°F. 75 ft. lbs., fatigue limit 28,000 lbs. @ 100,000,000 cycles) . . . high resistance to wear from erosion, abrasion, cavitation-pitting . . . high compressive strength (E. L. in Comp. 25,000 psi) . . . high modulus of elasticity (18,000,000) . . . easy to fabricate with Ampco-Trode* welding wire and coated electrodes.

Ampco Grade 8 has Boiler Code Approval and is available in sheet, plate, extrusions, pipe, tubing and fasteners. It may be the solution to your corrosion problems. Consult your nearest Ampco Field Engineer or write us for further information.

Tear out this coupon and mail today!

Fabricating Ampco Metal with Inert Gas Consumable Electrode Welding

*Reg. U. S. Pat. Off. Ampco Metal, Inc., Milwaukee, Wisconsin

Ampco Metal, Inc.

MILWAUKEE 46, WISCONSIN

West Coast Plant —

BURBANK, CALIFORNIA

AMPCO METAL, INC., Dept. PP-9, Milwaukee 46, Wisconsin

Send me information on the application of Ampco Aluminum Bronzes for corrosion-resistant service in the Process Industries.

Name ..... Title .....

Company .....

Company Address .....

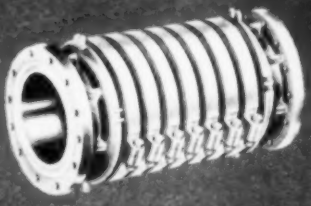
City ..... ( ) State .....

PP-7

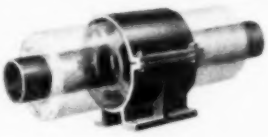
ADSCO EXPANSION JOINTS

ADSCO'S piston-ring expansion joints can be serviced *and* packed under full-line pressure. That's why they're best. Simple and compact, they will absorb expansion caused by temperature differential in pipes carrying liquids, gases, or steam. The high-polish surfaces of these joints can never be scored, because the slips are in contact only with packing. Misalignment is prevented by both internal and external guiding. Write for Bulletin 55-15G. Remember, only ADSCO makes all types of expansion joints. We don't have to sell what you don't want to buy.

CORRUFLEX



PIPE ACCESSORIES



ADSCO
75 YEARS OF LEADERSHIP

AMERICAN DISTRICT STEAM COMPANY, INC.
NORTH TONAWANDA, NEW YORK

PENBERTHY Liquid Level Gages

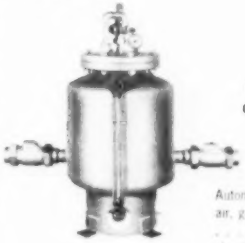
YOU CAN *Remove and Replace Without Shutdown*

Union connections between the gage and the valves permit removal of gage for repairs without shutting down the equipment. Just close the valves, uncouple the unions and remove the gage. The convenience of this is obvious. When glasses have to be replaced or repairs made, it is not necessary to work in an awkward position or to shut down. Another advantage: a gage needing repairs can be replaced immediately by a spare and the repairs made at leisure. There are many other reasons for the superiority of Penberthy Liquid Level Gages; ask for Catalog 35.

OTHER PENBERTHY PRODUCTS

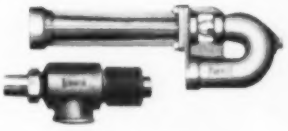
PENBERTHY TRANSPARENT GAGE

Used to observe color and density of liquids under high pressures and or temperatures. Exceptionally sturdy construction —liquid chamber machined from solid block of metal. Ask for Catalog 35.



PENBERTHY CYCLING JET PUMPS

Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.



PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Made in wide variety of materials and special units developed to meet unusual conditions. Ask for Bulletin 512.

PENBERTHY EXPLOSION-PROOF SUMP PUMPS

Motor and switch totally enclosed. Underwriter approved for Class I, Group D, and Class 2, Groups E, F and G hazardous location. Made of copper and bronze throughout. Ask for Bulletin 4929.

4672

PENBERTHY INJECTOR COMPANY

DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

DETROIT 2, MICHIGAN

Established 1886 — *Canadian Plant, Windsor, Ontario*

dried 3,000 years

. . . for quick-dried petroleum products you need Alcoa Activated Alumina

The petroleum industry has learned to rely on Alcoa Activated Alumina for the quick, efficient dehydration of liquids, gases and vapors so essential in maintaining production schedules. Thoroughly proved, Alcoa Activated Alumina has had a long and successful history in the drying of propane . . . butane . . . gasoline . . . distillate . . . residue gas . . . and scores of other petroleum products. Its desiccating properties have been equally effective in protecting finished oils from water contamination and in maintaining continuously-dry instrument air.

Commercially pure, Alcoa Activated Alumina has outstanding stability of physical form . . . will not break down due to repeated cycles of saturation and reactivation. Does not soften, swell or disintegrate in liquid water. Alcoa Activated Alumina is non-corrosive and practically iron-free.

Alcoa Activated Alumina dries to lower dew points than any other commercial desiccant. Moreover it adsorbs certain gases from gaseous mixtures and serves as a catalyst and catalyst carrier. If you are not already enjoying the economies it offers, write to:

ALUMINUM COMPANY OF AMERICA • CHEMICALS DIVISION
6161 Gulf Building, Pittsburgh 19, Pa.

Alcoa Chemicals

ALCOA **ALUMINAS and FLUORIDES**

ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • LOW SODA ALUMINAS • ALUMINUM FLUORIDE • SODIUM ALUMINUM FLUORIDE • FLUORIDIC ACID • CRYOLITE • SYNTHETIC

"SEE IT NOW" with Edward R. Murrow on CBS-TV Every Sunday . . . brings the world to your armchair. Consult your newspaper for local time and channel.

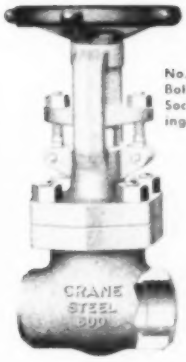
why CRANE 600-pound small steel gates are sure to meet your needs

You can't top these Crane Small Steel Gates for dependable performance on high pressure, high temperature lines . . . for ease of operation . . . for simplified maintenance. That's because they include design features normally found only in larger or more expensive valves.

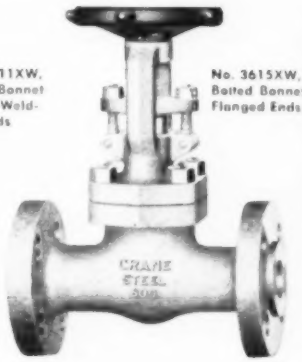
Then too, these Crane valves are available in a choice of types to meet your particular requirements. For example, with union or bolted bonnets; with screwed, flanged, or socket-welding ends; and in trim materials recommended for all common fluids.

GET NEW DESCRIPTIVE CIRCULAR AD-1881

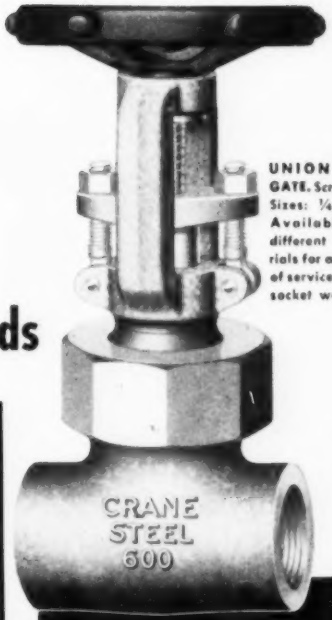
For complete information—including prices—about these longer lasting, easier operating Crane Small Steel Gate Valves. Ask your Crane Representative for your copy, or write direct. No obligation.



No. 3611XW, Bolted Bonnet Socket-Welding Ends

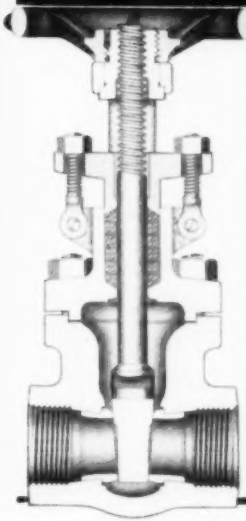


No. 3615XW, Bolted Bonnet Flanged Ends



UNION BONNET GATE. Screwed ends. Sizes: ¼ to 2-inch. Available in three different trim materials for a wide range of services. Also with socket welding ends

Easy to Operate... Easy to Service



EASY ACCESS to stuffing box assured by swinging gland eyebolts. Improved yoke design provides liberal working space.

DEEP STUFFING BOX filled with high quality asbestos packing rings maintains tight stem seal.

LEAKPROOF BONNET JOINT. Soft iron gasket in male and female joint cannot blow out.

T-HEAD DISC-STEM connection provides flexibility for smooth operation; prevents stem distortion or binding of parts.

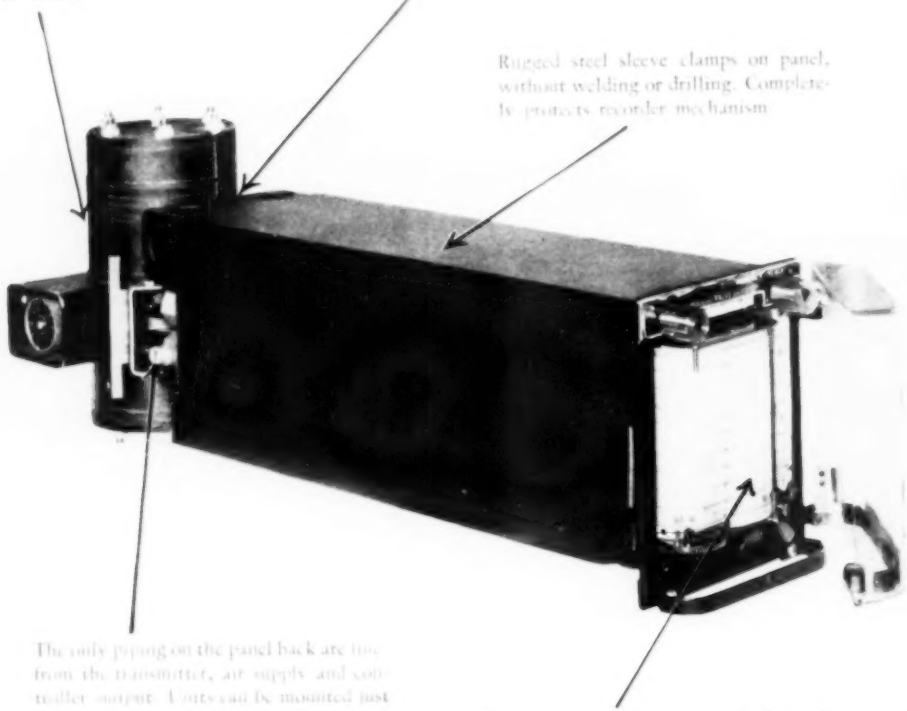
Cross-section No. 3607XW, Bolted Bonnet Gate, Screwed

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

PLUG IN


The plug-in controllers can be removed and replaced with another unit in just 10 seconds
One common, self-sealing manifold gives plug-in connections to both receivers and controllers!
Rugged steel sleeve clamps on panel, without welding or drilling. Completely protects recorder mechanism
The only piping on the panel back are lines from the transmitter, air supply and controller output. Units can be mounted just a few inches apart.
Recorder or indicator plugs in from the front. Units can be interchanged in just 10 seconds.

THE NEW IDEA IN PANEL INSTRUMENTATION

Taylor, pioneer in the 3-part control system brings many new refinements based on extensive field experience

1. Change from simplest to most complex control by simply pulling out one unit, plugging in another.

2. Change from indicator to recorder or vice versa in only 10 seconds.

3. One mounting for both controller and receiver — recorder or indicator.

4. Recorders or indicators can be mounted on the panel without welding, without drilling holes.

5. Only piping connections required are air supply, controller output, and to variable transmitter. All other connections made automatically in self-sealing manifold.

6. All adjustments can be reached without disturbing any connections.

7. Mountings are extremely simple and rugged.

8. You save panel space by mounting units a few inches apart.

9. Receiver mechanism totally enclosed by protective sleeve.

10. You save money on installation — thanks to simplified piping and mounting.

Be sure to get information on the new and greater plug-in type Taylor TRANSET Control before you make any decision involving pneumatic transmission control. Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

▼ ▼ ▼

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

ADDITIONAL NEW FEATURES IN TAYLOR'S TRANSET® RECORDER:

Continuous valve position indication on separate scale tells valve pressure at a glance.

Chart read back device gives easy access to past records without disturbing any function of the recorder or interrupting the record.

New chart drive mechanism for greater convenience, greater dependability.

Taylor Instruments

MEAN

ACCURACY FIRST

IN HOME AND INDUSTRY

24 ACRES *Cover the World*

. . . with TOP QUALITY

DROP FORGED STEEL

VALVES, FITTINGS and FLANGES

by

Vogt

Air View of
Henry Vogt Machine Co.

This 24 acre Vogt plant supplies the most comprehensive line of top quality *drop forged* steel piping materials anywhere available to industry. That's why they're the choice of leading refineries, power plants, chemical plants, etc., the world around!

OUR COMPLETE LINE INCLUDES

Flanged, Screwed and Socket Weld End Globe, Gate and Check Valves • Ells, Tees and Crosses • Couplings • Bushings • Plugs • Unions • Flanges and Flange Unions • Welding Heads

HENRY VOGT MACHINE CO. LOUISVILLE 10, KY.

Branch Offices: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

DU PONT

PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

September ★ One of a Series of Interest to the Petroleum Industry ★ 1952

HAVE YOU

recently taken advantage of the services offered to refiners by the 5 Du Pont Petroleum Chemicals Division district laboratories?

Here is a list of some of the services available:

1. Tetraethyl lead blending studies
2. Lead content analysis
3. Laboratory octane ratings
4. Road octane ratings
5. Antioxidant evaluations
6. Metal Deactivator recommendations
7. Dye selection
8. Recommendations in connection with fuel oil, lube oil, and grease additives problems

Ask your Du Pont Petroleum Chemicals Division representative for further information on how the district laboratories can be of help to you.

Easy Maintenance, Plus Added Safety, Marks Du Pont-Designed Metal-Flex Hose

With numerous installations already in use, the Du Pont-designed Metal-Flex unloading swing line has definitely proved its outstanding advantages.

Hardly any maintenance is required to keep the hose in working condition. This, added to the fact that only one man is required to connect and operate it, means that a Metal-Flex installation pays for itself in a very short time in lower labor and maintenance costs.

Refiners who have tested and used the Metal-Flex unloading swing line for a period of years report, moreover, that it is safer than any other type of unloading connection for TEL handling. Because it holds vacuum exceptionally well, it eliminates the minor leaks that so frequently result in unloading difficulties when rigid swing lines are used.

WEATHER RESISTANCE

Metal-Flex hoses have been installed all the way from Houston, Texas to Winnipeg, Canada. Throughout this wide range of weather and climate conditions they have been found to operate smoothly and easily at all times—in sleet and snow as well as in warm weather.

The Metal-Flex design was developed and built by Du Pont as a service to refiners who were expressly looking for a safer, more convenient connection that would overcome certain specific unloading problems.

Strategically Located Du Pont Rail Sidings Help Meet Emergency Needs for TEL Shipments

Whenever you have a "hurry-up" need for tetraethyl lead that has not been anticipated in your regular delivery schedules, there is a Du Pont TEL tank car loaded and waiting at a nearby rail siding ready for immediate delivery to your refinery. Primarily for emergency use, the Du Pont "rolling warehouse" facilities include seven rail sidings in addition to the plant storage area, as well as two tank truck terminals strategically located throughout the country.

THIS MAP SHOWS how the Du Pont TEL tank car sidings and tank truck terminals are conveniently located in, or adjacent to, major refining areas.

The TEL *tank car* facilities serve refiners from railroad sidings in Torrance and El Monte, California; Houston and Beaumont, Texas; East Chicago, Ill.; Kansas City, Mo.; Toledo, Ohio; and Carney's Point, N. J. The *tank truck* terminals at El Monte, Calif., and Carney's Point, N. J., are complete with weigh tanks and storage facilities and make it possible for refiners to receive rush shipments of TEL in smaller-than-tank-car lots.

FOR EMERGENCY USE . . .

The main purpose of this nation-wide Du Pont TEL distribution set-up is to keep on hand an adequate supply of tetraethyl lead to supplement regularly scheduled deliveries that may have been held up by floods, train accidents, strikes or other unforeseen circumstances.

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED

Rail Sidings

CONVENIENCE, TOO!

A second advantage of these siding and terminal facilities is the convenience they provide refiners who need additional supplies of tetraethyl lead on a moment's notice — for rush orders as to meet unusually big commitments.

An ample supply of both Motor Mix and Aviation Mix is always maintained. And there is someone at the plant to expedite your order at any time of the day or night. Deliveries are fast, too. Most requirements can be filled in a matter of hours, depending on the distance to your refinery.

24-HOUR SERVICE

Here are two examples of how a Du Pont "warehouse on wheels" has operated to the customer's advantage.

Due to a recent strike, one refiner was called on to step up his production schedule for a short period. But he didn't have the necessary "lead" on hand for such an accelerated program. So he put in a call to the nearest Du Pont Petroleum Chemicals Division district office.

With a loaded TEL tank car on a nearby siding, Du Pont was able to deliver his order to the refinery within 24 hours.

In another instance, TEL cars en route to the West Coast were held up by floods. The delay could have meant a serious loss of production time for the West Coast refineries. But the Torrance and El Monte sidings were able to deliver enough TEL to keep the refineries producing on schedule until the regular shipments arrived.

FULLY-STOCKED WAREHOUSES

In addition to the above mobile units handling tetraethyl lead, Du Pont also maintains three fully stocked warehouses in Houston, Los Angeles, and Wilmington, Del., which carry a supply of all other Du Pont gasoline additives.

Automotive Technologist

JAY BRENT MALIN

A specialist in internal combustion engines, J. Brent Malin joined the Du Pont Company in 1951 as an automotive technologist.

Much of Malin's work consists of assisting oil companies in solving product application problems—particularly those pertaining to large fleet operations. In cooperation with automobile manufacturers, he also works on engine developments pertaining to fuel and lubricant applications . . . and keeps up-to-date on significant automotive trends.

Malin came to Du Pont from North American Aviation where he applied his knowledge of combustion characteristics to the development of rocket motors. Prior to this, he spent 10 years in engine research and development work at The Texas Company.

What's in a Name?

Your company's name is one of its most important assets. It stands for your reputation for producing dependable products, as well as for the company's personnel and material assets.

And since your brand name represents your company in competition, it is important that your dealers and customers use the name whenever they refer to your gasoline brand . . . and know the quality features that distinguish it from other brands.

When you encourage motorists to use your brand names rather than such vague terms as "regular" or "premium," you are encouraging them to distinguish between your brands and all other gasolines.

To help stimulate dealers to promote your brand names more aggressively—and the quality features for which they stand, Du Pont has developed a unique brand name presentation. It is suitable for showing at dealer meetings and can be highly individualized to point up the distinctive selling features of your own gasolines. It is available to all oil companies.

MOVIES AVAILABLE

Prints of the following Du Pont films are available to oil companies for training and public relations purposes. They may be borrowed or purchased. Address request to nearest Petroleum Chemicals Division district office.

Pipeline on Wheels—A 26-minute, full-color movie on tank truck safety. Suitable for both training and public relations purposes.

What Makes a Gasoline Good—An 18-minute cartoon movie in color. Presents the story of how high quality gasoline is made in easy-to-understand form. Ideal for dealer training meetings.

In addition to the above, Du Pont makes available a special library of films of particular interest to the petroleum industry.

DU PONT

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: New York, N. Y. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

IN CANADA: Canadian Industries Limited—Toronto, Ontario—Montreal, Quebec—Calgary, Alberta

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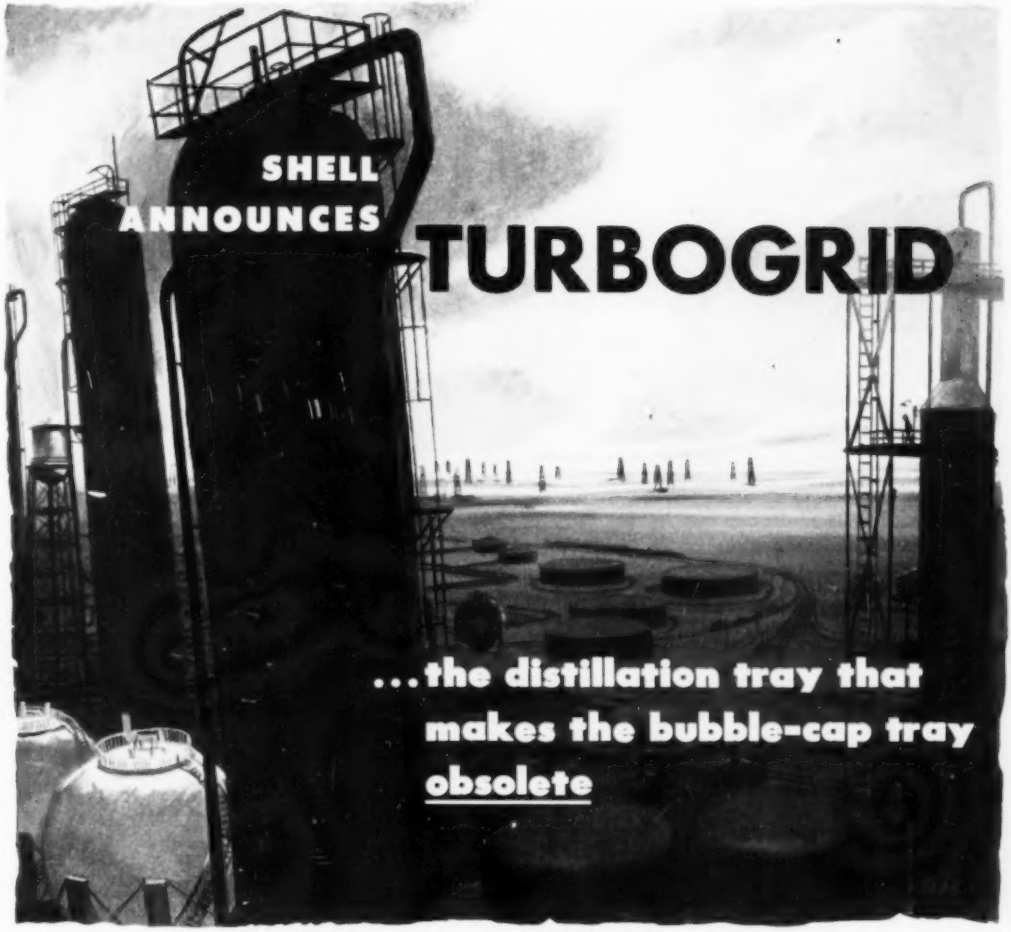

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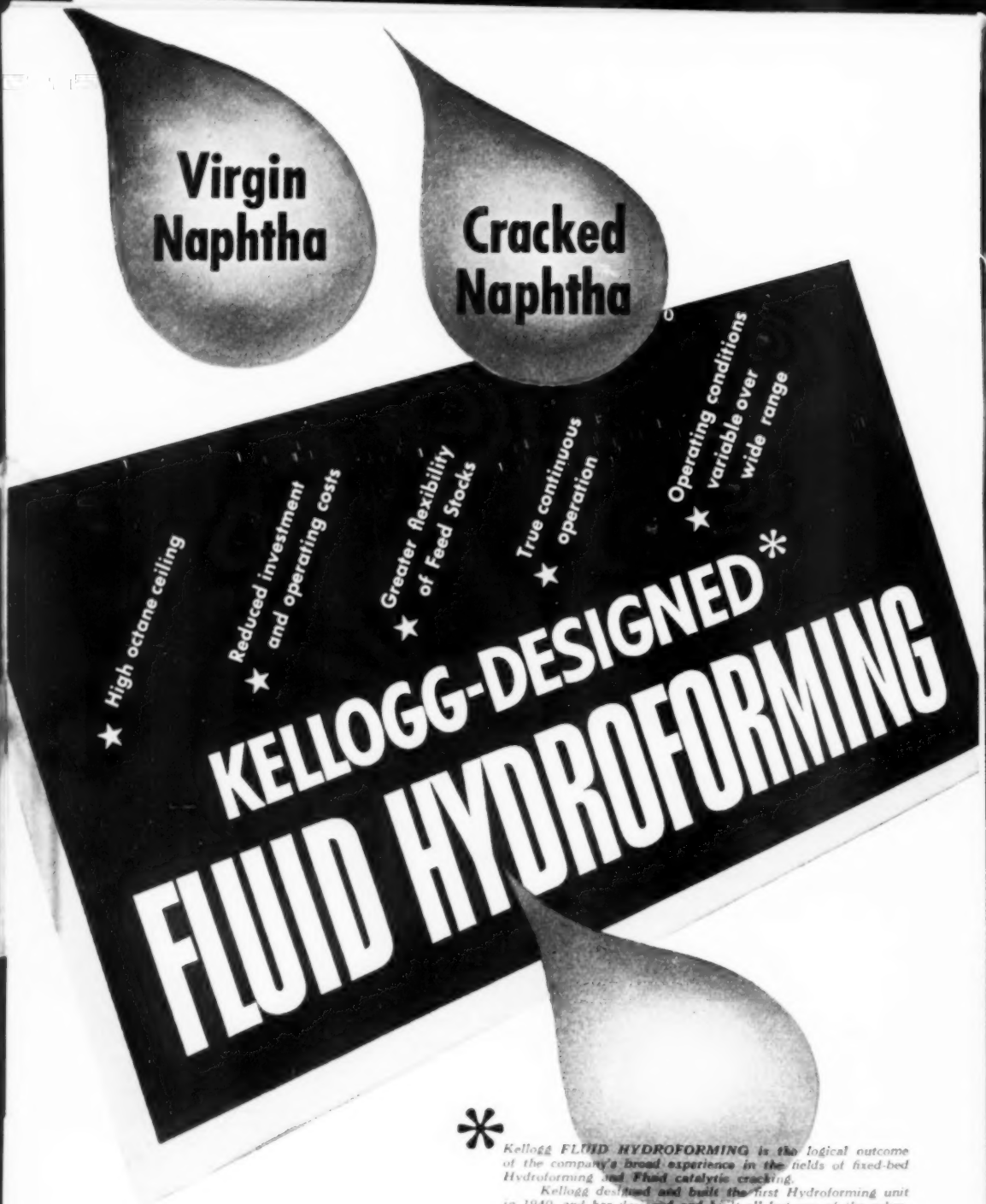

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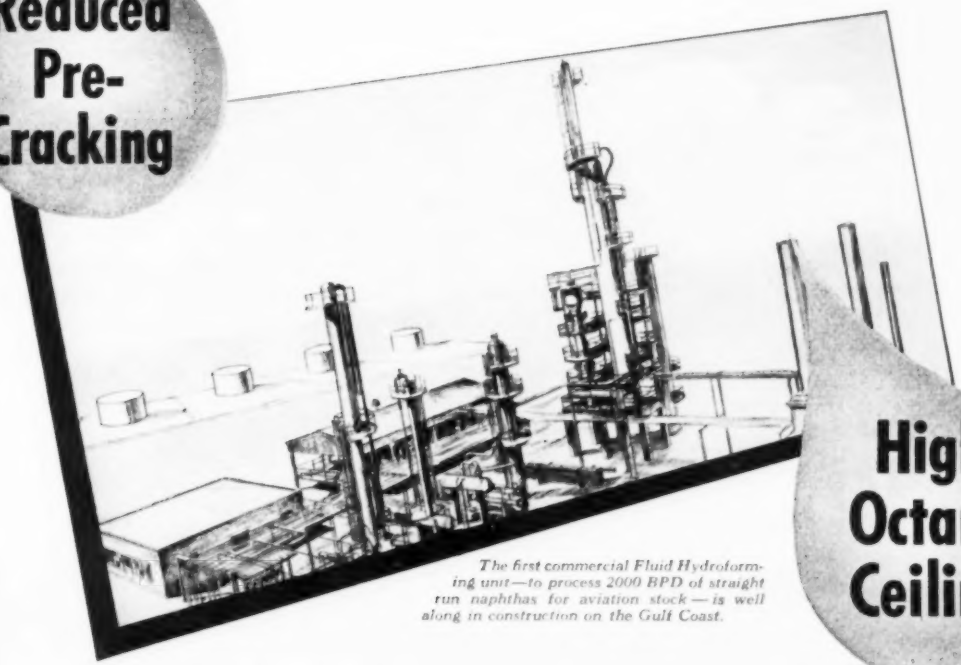

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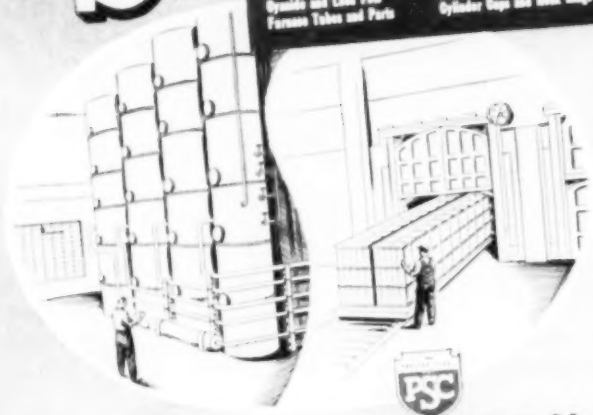

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FRICTION, NOT CORROSION, is chief bugaboo in automotive engine wear according to study by these Standard Oil Development engineers — L. E. Moody, J. F. Kunc, Jr., and D. S. McArthur

FRICTION

Main Cause of Engine Wear

MORE than two years study by Standard Oil Development Co.'s automotive research staff has convinced these investigators that plain old-fashioned friction is the chief cause of wear in automobile engines.

Their research questions that corrosion under low temperature operating conditions, heretofore accepted as the main factor in wear of cylinder walls and piston rings, is more than a minor cause of this type of engine deterioration. Abrasion, they believe, is also a relatively small factor in engine wear. Their work also shows that heavy engine deposits in the form of oil ring and oil screen plugging cause only a small proportion of engine failures.

The studies on this subject by Standard Oil Development Co., and those by other oil companies, automotive concerns and other agencies, reflect the growing recognition of the cost to the public of cylinder wear in their automobile engines. One authority puts this cost, in terms of engine overhauls or replacement, at over $1,000,000,000 annually. It further estimates that a large portion of the 3,000,000 vehicles scrapped annually in the U.S. go to the junk heap because their engines are worn out cylinder-wise.

SOD's "Engine Wear" research project is based on both laboratory work and extensive field tests. In one part of the field work the technologists themselves put on jumpers and went into garages and engine rebuilding depots to examine the engines of over 100 popular-make passenger cars brought in for overhaul.

The findings to date from the Standard Oil Development Co.'s work were reported at the Summer Meeting of the Society of Automotive Engineers, in June in Atlantic City, in a paper by J. F. Kunc, D. S. McArthur and L. E. Moody, all SOD technologists*. The results are considered important enough that the studies are being continued and broadened, now including radioactive tracer techniques for measuring wear of engine parts. Selected lubricants, including synthetic oils, and types of additives are also being studied for their effectiveness in reducing the rate of wear in high temperature engine operation, where friction rather than corrosion or abrasion is generally accepted as the main source of wear.

The relative proportions of wear attributable to corrosion or to friction at present are debatable, it is recognized, and should be the subject of further study in laboratories and field tests. An additional reason why the SOD investigators are emphasizing their research on means for overcoming wear due to friction by se-

* "How Engines Wear," J. F. Kunc, Jr., D. S. McArthur and L. E. Moody, Kunc Laboratories, Research Division, Standard Oil Development Co., Linden, N. J., presented at Summer Meeting, Society of Automotive Engineers, Atlantic City, June 9-13, 1952.

TRANSPARENT PLASTIC REPLICAS of worn surfaces improved accuracy of friction observations

lected lubricants or mechanical means is that relatively little work has been done in this field. On the other hand, the amount of work already done on corrosive wear has led to the development of crankcase oils for effectively reducing this type of engine wear.

The SOD investigators also believe that the new techniques for studying the behavior of metals and lubricants in service may provide the means for establishing that some engine wear now attributed to corrosion may actually be through friction. To illustrate this possibility, they refer to the present difference of opinion among authorities as to whether "bulging corrosion" is actually corrosion or friction wear. This condition first came to light when the wheel bearings of cars which had been shipped from the factory some distance by rail had failed after relatively little service. Examination disclosed the finish vibration had caused tiny particles to wear off the bearing surfaces. It was believed that corrosion was the cause of this wear. It is now considered a possibility that the wear was from friction and that the tiny bits of iron worn off oxidized, thus giving the appearance of being corroded.

While there may be disagreement among oil company technologists and automotive engineers as to the exact cause of engine wear, all are in accord on the seriousness of this factor in reducing the life of an automobile engine in service. It is accepted that the engine is now the limiting factor to the useful life of the vehicle and that the engine in turn is limited by cylinder and ring wear. In SOD's examination of engines brought in for overhaul, where possible, mileage figures were obtained on the engines. It was found that, on the average, the car's engine lasts only half as long as the car. "It would be a tre-

Table 1—Reasons for Engine Overhaul

Overhauled Because of	% of Engines
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total Badly Worn	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total Examined	[illegible]

mendous advantage to the car owner if his engine would last (without overhaul) as long as his car," succinctly states the SOD report.

The first work in the study of how automobile engines wear was a survey in the New York metropolitan area to determine why engines are brought in for overhaul, it is brought out in the SAE paper. It was agreed by garage and rebuilders that cars are brought in for overhaul because they are "burning oil." Field tests conducted by Esso Laboratories had indicated that high oil consumption can result from either heavy engine deposits or excessive engine wear. The attempt was made to learn which is the real offender in limiting engine life.

By arrangement with garages and engine rebuilders, over 100 popular-make passenger car engines were examined by SOD technologists as they were dismantled for overhaul. Each engine was rated for engine deposits such as sludge, and oil ring and oil screen plugging. In addition wear measurements were made on each engine. Cylinder wear at the top of ring travel was measured and the ring gaps were determined by bringing the worn rings back to the laboratory and measuring them in a standard ring gauge. The bearings, valves and other engine parts were examined for evidence of failure. In each instance, on the basis of the inspection made, a decision was reached as to why the engine required overhaul.

The results of this part of the work are given in Table 1 and discussed in the paper as follows: "Of the engines examined, 57% had been brought in solely because of excessive engine wear. These engines were relatively free from deposits and showed no evidence of mechanical failure. The wear was excessive. Median cylinder wear in these cars was 15 thousandths of an inch, and 30% of the cars actually had cylinder wear in excess of 20 thousandths of an inch.

"The ring gaps (in standard gauge) were at least 6 times the manufacturer's recommended gap. In some instances the ring gaps exceeded 200 thousandths compared with the recommended gap of 10-15 thousandths inch. It is obvious these engines had been brought in for overhaul because they were worn out.

"Of the engines examined, 20% had both high wear and heavy deposits. In these instances it was not possible to lay the blame solely on either the deposits or the wear. There was no way of knowing which was the primary cause of engine failure. In another 8% of the engines, excessive wear was accompanied by some type of mechanical failure. All told, 85% of the engines examined were excessively worn. Heavy deposits

alone accounted for only 5% of the failures. It was concluded that engine wear was the principal cause of engine failure."

In the next step in the SOD Engine Wear project, as brought out in the paper, the worn surfaces of the piston rings from the engines surveyed in the field were examined to see what could be learned about how the engines had worn. To get a basis for comparison, three special wear tests were run in a Lauson laboratory engine. One test was under high temperature friction type conditions, the engine being run for 800 hours at jacket temperature of 180 F. Another test was run under abrasive conditions. Test conditions were identical with those in the first test, except that 0.5% of 500 mesh carborundum was dispersed in the oil. The engine lasted five hours. The third test was run for 10 hours with the jacket temperature held at 60 F, to promote low temperature corrosion.

The worn ring surfaces from each of the Lauson engine tests were then examined, using a replica technique applied for the first time, as far as is known, in this type of work. In this technique a transparent plastic replica of the ring surface was shadowed with chromium, which greatly accentuated the surface differences, and then examined under a microscope at 110 magnifications. In this way it was possible to distinguish between each of three types of wear, as shown in Fig. 1. On this point the paper states:

"It was found that a friction worn surface is relatively smooth, an abraded surface is heavily ridged, and a low temperature corroded surface completely covered with pock marks and craters. In subsequent work it was found that, if an engine had operated for even a short period of time under low temperature corrosive conditions, the resulting pockmarks and craters are not erased even after 100 hours of operation under friction type conditions. The differences in the appearance of these worn surfaces provided a means for determining what type of wear had occurred in the field engines.

"Replicas of the field ring were made and examined under the microscope in the same manner. It was found that by far the biggest proportion of the field engines appeared to have worn by friction and abrasion. Pictures of typical field ring surfaces are shown in Fig. 2. Ninety per cent of the surfaces examined appeared to have been worn by either friction or abrasion or a combination of the two. What appeared to be low temperature corrosive wear was observed in only 10% of the engines.

"It was concluded from this experiment that most engine wear occur-

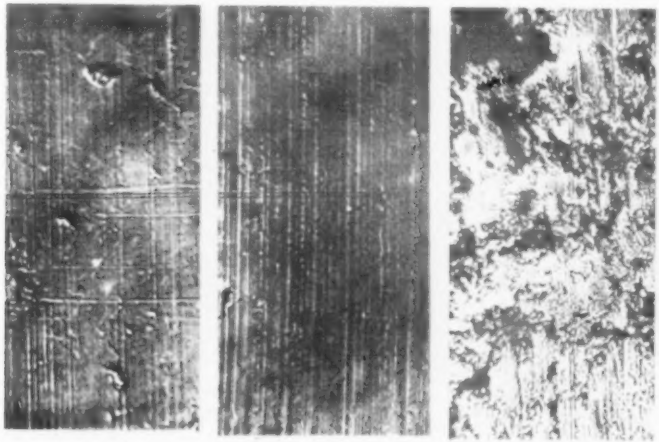


FIG. 1. Three types of wear on ring surfaces in laboratory tests.

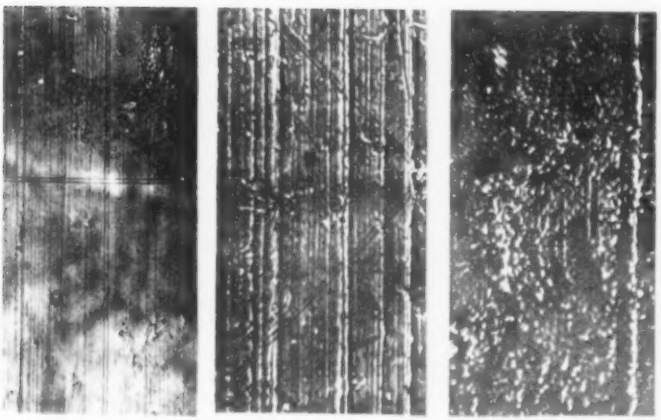


FIG. 2. Typical worn surfaces from field tests. Figures are percentages of engines showing each type of wear.

Table 2—Comparison of Different Types of Wear in a Lauson Engine

Wear Mainly Due to	Conditions	Ave. Top Ring Weight Loss, Mgms./Hr.
Friction	800 hrs. at 180 F. jacket temperature	0.06
Abrasion	5 hrs. at 180 F. jacket temperature, 0.5% 500 mesh carborundum in oil	0.60
Low Temperature Corrosion	10 hrs. at 60 F. jacket temperature	0.10

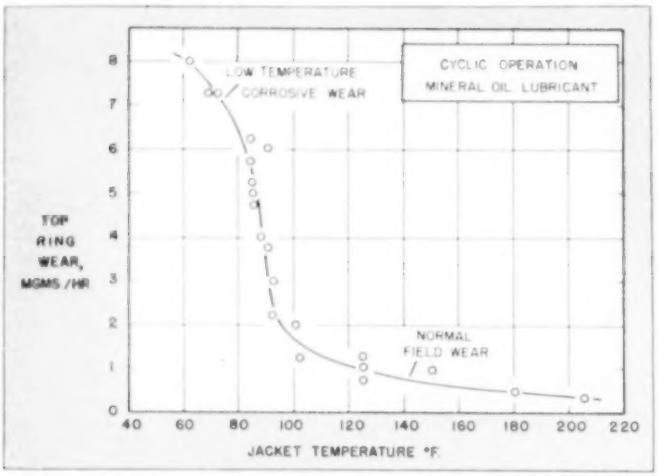


FIG. 3. Effect of jacket temperature on Lanson engine wear.

FIG. 4. Piston top ring surfaces all resembled friction wear.

ring in the field is due to friction and abrasion. The abrasive wear seems to be mild. Most of the wear rates compare with that for friction type wear."

Friction wear is much less severe than low temperature corrosive wear, the paper brings out and illustrates in Table 2 which shows the wear rates obtained in the three Lanson tests described earlier. In laboratory engines, friction wear is stated to be at least an order of magnitude less severe than low temperature corrosive wear. The pronounced effect of jacket temperature on wear as shown in Table 2 has been well established, it is stated. As shown in Fig. 3, the wear rates jump sharply when the jacket temperature in a single-cylinder Lanson engine is held below 100 F.

Data are not available on the jacket temperature required to produce low temperature corrosive wear in the average passenger car engine," the paper states. "However, the appearance of the worn surfaces suggests

Table 3—Comparison of Laboratory and Field Wear Data

(Light Delivery Trucks, Stop-and-Go Service, Parked Outside Through the Winter)

Lubricant	Top Ring Wear Rates, Mg. Hour— Lanson Engine, 60 F. Jacket Temp.	Delivery Trucks at 20,000 Mi.
Oil A	4.2	0.09
Oil B	3.5	0.58
Oil C	2.0	0.53

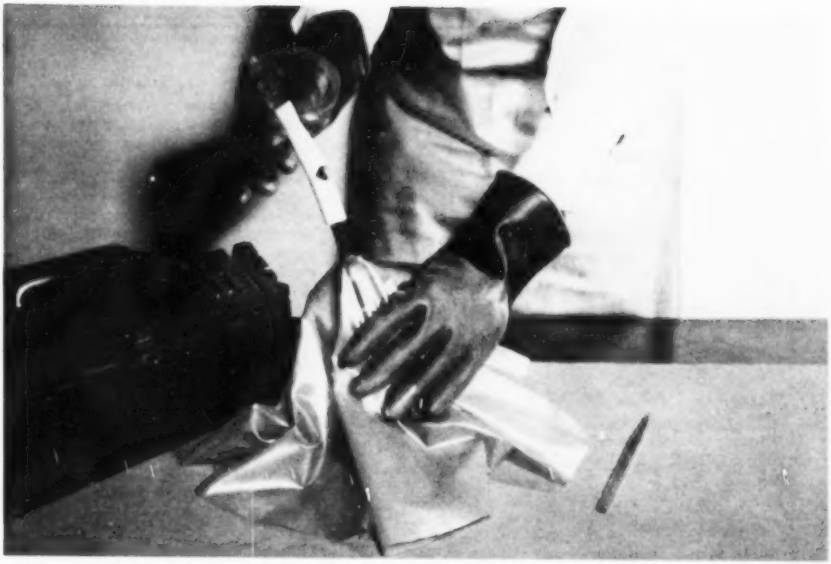
that low temperature corrosive wear is not common in average operation. Apparently, most engines are worn by friction and mild abrasion at rates corresponding to the lower wear level shown in Fig. 3 rather than at the higher level."

Measurements of actual wear rates in a field test running over a period of two years substantiated the conclusion that most engines are worn by friction and abrasion at low wear rates, rather than at the higher level of corrosive wear. In the field test three oils were run under low temperature stop-and-go type conditions, four light delivery trucks being operated on each oil. The trucks were used in light delivery service in northern New Jersey. The fleet was operated over a period of two years on premium quality fuel and covered 20,000 miles. The trucks were parked outside at night during winter to assure severe low temperature conditions.

It was believed by the SOD investigators that, if low temperature corrosion were important in average operation of cars it would be evident in this fleet test. It was discovered, however that the wear rates with all the oils were of the same order of magnitude as that obtained in laboratory engines operated under high temperature conditions, e.g., in the range of 0.3-0.6 mg. top ring weight loss per hour.

In addition, oils which were known to be good in the laboratory in reducing low temperature corrosive wear did not show up to advantage in the field, as shown in Table 3. Oil A was much poorer in the laboratory Lanson engine than Oils B and C when the engine was run under low temperature corrosive conditions. However, in the field Oil A was better than Oils B and C. Upon examination, the ring surfaces from the engines operated in the field all resembled friction worn surfaces, as shown in Fig. 4.

In conclusion," states the SAE paper, "it appears that friction along with some mild abrasion is the principal cause of engine wear. Low temperature corrosive wear does not seem to play an important part in wearing engines in average field service. It is felt that efforts should be directed toward reducing frictional wear in engines as a means of solving the engine wear problems."



OPENING BROMINE BOTTLES is now a safe operation in the Shell Development laboratories, but two serious accidents pointed up the need for this improved procedure

Make Your Research 'Lab' Safe

Shell Development's research personnel combat hazards through diligent program of safety consciousness

By N. W. JACOBSEN
Shell Development Co.
Emeryville, California

PEOPLE who make up a research laboratory are there because of their ability to do original thinking and creative work in the solution of scientific problems. When these abilities are applied to safety problems it is reasonable to expect that an expert solution will result, particularly when the same careful attention is given to the safety aspect of the problem as would be given to an operational problem. The research worker does not always recognize hazards of the work, but when such hazards are pointed out, with proper evaluation of the condition, the researcher will generally apply sound judgment. There are some problems that must be considered primarily by safety personnel since authoritative codes are involved and must be incorporated into the preventive scheme.

When circumstances permit, the worker should be given the opportunity to provide his own corrective measures. For example, the illustration at the start of this article shows the protective operation devised by a laboratory worker for the *safe* opening of bromine bottles. Prior to the development of this safety practice we experienced two injuries in bromine bottle opening; one was a potentially serious eye injury, the other a serious hand laceration.

The new procedure is a rather unique application of an old method for opening small glass ampoules. A piece of heavy-walled rubber tubing of large enough diameter to slide over the neck of the bottle is provided with a notch. The notch exposes sufficient area on the neck of the bottle to scratch the glass with a file for breaking. After the file scratch is made and with the rubber tubing still in place, the neck is broken in a fashion similar to that used for breaking glass tubing. One of the most important items in any such glass-cutting job is of course a sharp file.

The other protective items for opening bromine bottles safely include gloves, plastic apron, and face shield (which is not shown). These are items normally used in the laboratory when handling corrosive materials. The plastic cover over the bottle protects against splashing of the liquid if the bottle is accidentally broken. The box shown for containing the necessary gear is equipped with a jig to hold the bottle in a steady position while the filing is done.

Six Safety Problems To Consider

The recognizable safety problems in analytical research include:

1) Use and storage of flammable liquids.

2) Toxicity of chemical products or reagents.

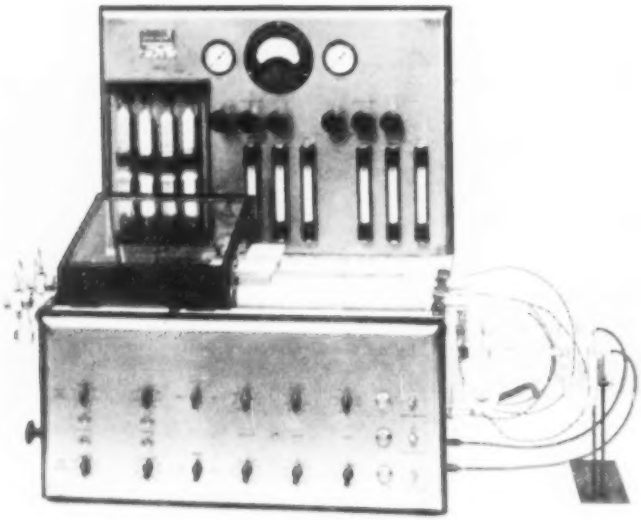
3) Size of the material sample.

4) Lack of information concerning the hazards associated with samples to be analyzed.

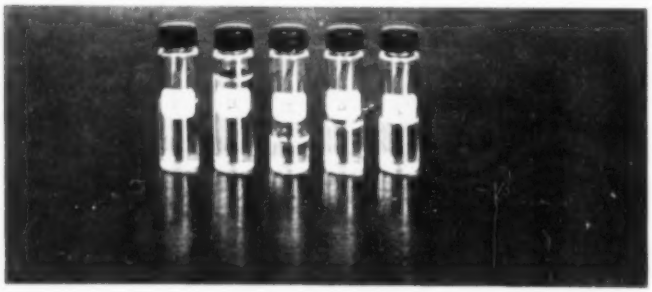
5) Physical hazard arising from the use of apparatus.

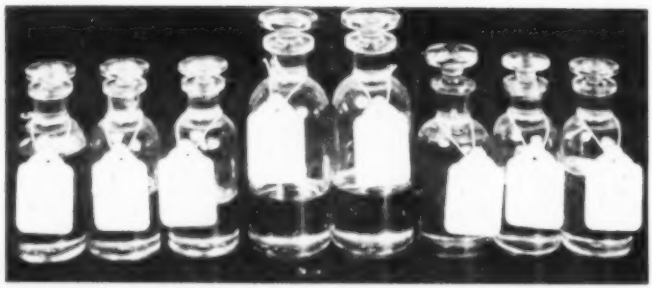
6) Training of workers who apply the methods.

Large and concentrated analytical laboratories nearly always face the problem of the safe use and storage of flammable liquids, and the practice usually adopted is to limit the quantities stored or used in a given location. Such limitations should apply to common flammable solvents such as acetone, isopropyl alcohol, methyl ethyl ketone, and to flamma-



SAFETY SHIELDING can easily be added to apparatus design as in this carbon and hydrogen combustion unit





PROPER LABELING of samples for analysis outlaws non-descriptive designations, color codes, and easily detachable and lost tags

ble chemical reagents and flammable samples that are retained.

Special cases may arise in which undue hindrance to laboratory operations would result from the observance of such a regulation. Then good judgment must be applied to determine what quantity can be used as a working minimum in the special situation without constituting a serious hazard. In any case it is essential to maintain periodic checks of the storage of flammable materials to ensure minimum retention. It is also necessary to encourage extreme care on the part of the employe. Among other things he should post warnings, recognize and remove ignition sources, warn others, use catch-all trays, and finally remove warning signs when the work is complete. Since complete success has not been achieved generally in eliminating fires in flammable liquid handling, small quantities included, it is necessary also to provide training in extinguishing methods.

Chemicals used in a research laboratory range from those which are entirely harmless to those which are dangerous if improperly handled. Since the potentially dangerous chemicals are probably in the majority, it is necessary to be aware of and alert to possible hazards, and to see that the chemicals are handled properly and do not endanger the user's safety or the safety of others. Proper handling consists not only in taking precautions to prevent untoward happenings but in planning the work to minimize serious consequences should an accident occur.

The chronic toxic effects of chemicals require the greater attention toward preventive and protective measures; acute intoxication is less likely except in low dosage materials such as organo-phosphorus compounds. The user should be suspicious of all chemicals until they have been proved innocuous.

Shielding Should Be Provided

The physical hazards arising from analytical apparatus itself are exemplified by combustion apparatus such as Liebig Carbon and Hydrogen Units, Quartz Tube Units for determination of sulfur and halogens and Wet Oxidation Units for determining carbon. Not all users of this type of equipment provide shielding for the combustion tube to protect the operator. Is this supposed to be unnecessary because the sample size is extremely small? This can certainly be an erroneous interpretation which points up an everlasting problem in analytical chemistry.

Because laboratory workers do not generally handle large quantities of a material there is a tendency to assume that hazards are negligible.

They certainly are not and the research laboratory staff should protect against potential hazards of combustion apparatus as consistently as an intelligent machine shop management protects against potential hazards of moving parts. Such measures are particularly necessary in the face of ignorance or carelessness by inexperienced laboratory personnel. Moreover, since we are constantly improving the technical aspects of laboratory apparatus, we would be lax in neglecting improvement in safety.

The safety training of the employee who applies the analytical methods should take into account the size of the material sample and the frequent lack of information regarding hazards in its use. An analytical group, concerned as it is with the identification of chemical compounds, their physical or chemical properties or their component parts, and the development of new methods usually uses samples of small size which should normally reduce handling hazards. Such is all too frequently not the case. It would almost seem that the smaller the sample the greater the hazard, since respect for the material tends to decrease directly as the amount used decreases and as the time of use without incident increases.

Insufficient Information Hazardous

Hazards in the handling of chemicals during analytical work do not always arise from the behavior of the analyst, but often from failure of the chemist who presents the sample to provide sufficient information concerning handling precautions. Some concerns require that all materials submitted for analysis be properly labelled with chemical name and special handling instructions. Even in such cases, there may be relaxation of this practice, which places undue responsibility upon the analyst for determining safe handling procedures.

Reasonable safety can be achieved through a work request form provided with a check list for indicating hazardous properties requiring consideration by the analyst. The properties might be specified as toxic, skin irritant, lachrymator, explosive or pyrophoric, peroxidic, unstable, flammable. (See accompanying illustration of a work request form on which check-off boxes provide a positive, convenient means for indicating potential hazards).

This information, together with the review of all materials received for analysis by a responsible person prior to actual handling, can provide reasonable assurance for safe handling.

Presented Before Section on Analytical Research, API Division of Refining Meeting, San Francisco, May 12-15, 1952, under the title "Safety Problems in Analytical Research."

ANALYTICAL DEPARTMENT

REPORT NO.:

WORK REQUEST

MAKE OUT THIS REQUEST IN ACCORDANCE WITH INSTRUCTIONS ON REVERSE SIDE OF PINK SLIP (SEE ABOVE)

AUTHORIZED BY — DATE

SUBMITTED BY — PHONE — NO. SAMPLES

WORK ORDER NO. — ROOM NO. — BOX NO.

MATERIAL — CHECK WHEN APPLICABLE

- ☐ No More Sample
- ☐ Valuable Sample — Return All Possible
- ☐ Toxic
- ☐ Skin Irritant
- ☐ Lachrymator
- ☐ Explosive or Pyrophoric
- ☐ Peroxidic
- ☐ Hygroscopic
- ☐ Volatile
- ☐ Unstable
- ☐ Flammable

ANALYSIS REQUIRED (Specify duplicate when required)

REMARKS

POTENTIAL HAZARDS in samples can be indicated by providing a work request slip with check-off boxes.

Meet the Author

N. W. Jacobsen received his B. S. from the University of California, College of Chemistry, in 1945 and since then has done graduate work there in the chemical engineering and industrial hygiene fields. He has been Safety Engineer for Shell Development Co. for the past five years and a member of the safety group for the past nine years. He is currently responsible for safety and fire prevention and protection, and acts as consultant on safety for Shell's laboratories and pilot plant operations.

Refining Properties of New Crudes

Part 7—Crude Oils from Recent Discoveries in Canada

By C. M. McKINNEY and H. M. SMITH*
Bureau of Mines Petroleum Experiment Station, Bartlesville, Okla.

Routine analyses of 11 crude oils from nine Canadian fields are discussed, and tabulated data from the analyses are presented. Data from complete inspection tests, including octane numbers of gasolines and cetane numbers of Diesel fuels from crude oils from two of the larger fields, are given. Yield and quality of other commercial products obtainable from Canadian crude oils are compared with similar products from other crude oils.

SINCE the discovery in 1947 of Leduc field in Alberta Province and the subsequent discovery of Redwater, Stettler, Big Valley and others, the volume of crude oil produced in Alberta has increased several fold and currently has considerable importance to United States and Canadian refiners. The Bureau of Mines has received several requests for analyses of oils from recently discovered fields in Alberta. To satisfy this need samples were requested, and the analyses discussed in this article were made.

Details of the method of analysis used are explained fully in a bulletin recently the Bureau of Mines routine crude-oil analysis.[1] A previous report issued by the Mines Branch of the Canada Department of Mines and Technical Surveys[2] contains a large number of analyses of crude oils similar to those discussed in this report, from Canadian fields. Except for analyses of oils from four fields, however, the analyses are of oils from other fields than are considered here. The Bureau of Mines has published analyses of crude oils from Leduc and Redwater fields in a report containing analyses of crude oils from several foreign fields.[3]

Eleven samples were obtained from nine fields, the location of which are shown on the map in Fig. 1. Numbers on the map correspond to the item numbers in Table I, where data from the routine analyses are summarized. For convenience in making comparisons, summary data from routine analyses of crude oils from the East Texas and Oklahoma City fields are included in Table I.

The location of Coleville (item 4 in Table I) in Saskatchewan Province is not shown. Its importance as a producing field is not known at this time and it is omitted from the discussion that follows.

All Alberta samples except that from Campbell field were produced from the D-2 and D-3 zones of the Upper Devonian. The Campbell sample was produced from the Blairmore sand of the Lower Cretaceous. Producing depths ranged from 2,514 ft. for the D-2 production from Big Valley to 6,047 ft. for the D-3 production from Wizard Lake.

Six of the oils from five fields contain enough sulfur to be classed as high-sulfur, over 0.5 wt. %. Of these, only two exceed 1.0%. Stettler oil with 1.16% and oil from the D-2 zone in Big Valley with 1.09%. The oils produced from Golden Spike,

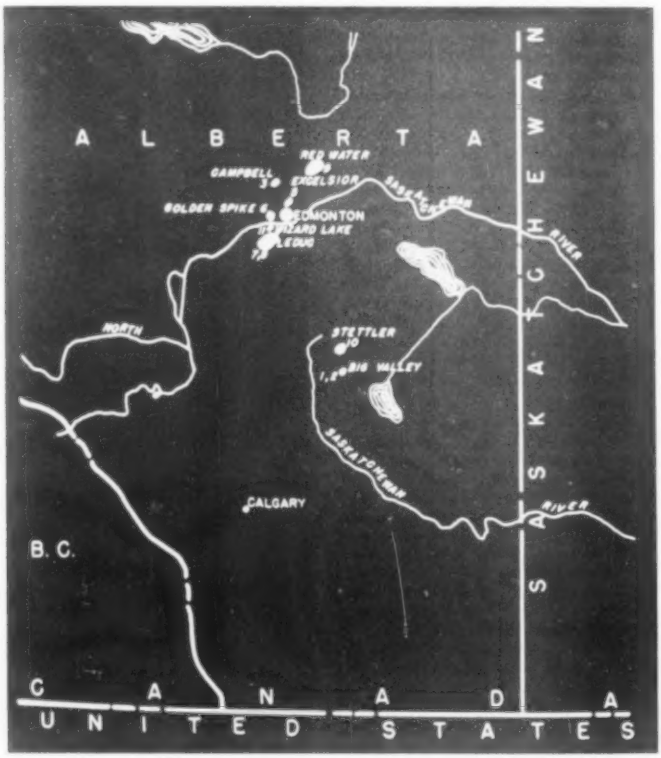


FIG. 1. Approximate locations of Canadian fields from which the crude samples in Table I were obtained.

Table 1—Summary of Pertinent Data for Canadian Crude Oils

PART 1—DATA SHOWING SOURCES AND GENERAL CHARACTERISTICS OF SAMPLES

Item	Sample	Field	Province	Producing formation and age	Depth, ft	Year of discovery	Gravity, °API	Color*	Sulfur, wt. %	Saybolt Viscosity 100° F., sec.	Carbon residue wt. %
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	51025	Big Valley	Alberta	Upper Devonian	2,934-2,942	1950	35.8	B.B.	1.00	52	3.9
2	51000	Big Valley	Alberta	Upper Devonian	2,934-2,944	1950	34.2	B.B.	1.1	57	2.9
3	51068	Campbell	Alberta	Beaverhill Lake	5,864-5,880	1949	40.0	B.B.	.90	41	2.7
4	52012	Dollerite	Saskatchewan	Lower Cretaceous	2,900-2,910	1951	14.1	B.B.	1.39	1,400	10.2
5	51067	Excelsior	Alberta	Upper Devonian	5,820	1949	36.0	G.B.	.84	40	2.7
6	51096	Golden Spike	Alberta	Upper Devonian	5,880	1950	37.6	B.B.	.24	42	1.2
7	49042	Leduc	Alberta	Upper Devonian	4,940	1947	40.8	B.G.	.30	38	1.7
8	49043	Leduc	Alberta	Upper Devonian	4,940	1947	40.8	B.G.	.30	42	1.5
9	49048	Redwater	Alberta	Upper Devonian	3,100	1948	34.8	G.B.	.95	45	4.1
10	51028	Stettler	Alberta	Upper Devonian	5,200	1948	39.2	B.B.	1.40	60	3.5
11	51065	Wizard Lake	Alberta	Upper Devonian	6,047	1951	37.0	B.B.	.24	41	1.6
12	49055	East Texas	Texas	Woodbine	Upper Cretaceous		37.8	B.B.	.36	34	2.8
13	49146	Oklahoma City	Oklahoma	Wilcox	Tertiary		38.2	B.G.	.19	47	1.1

PART 2—ANALYTICAL AND COMPILED DATA

Item	Volume percentages — Fractions — 1-3, inc. (light gasoline)	4-7, inc. (naphtha)	8-12, inc. (kerosine and gas oil**)	13-15, inc. (lubricating oil**)	Residuum	Correlation index averages of fractions 4-7, inc.	8-12, inc.	13-15, inc.	Characteristics of residuum % on gasoline-free basis	Specific gravity
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
1	9.7	16.6	22.2	17.4	30.5	26	34	42	44	0.940
2	13.1	13.7	23.2	17.2	28.0	30	35	39	42	.967
3	7.9	22.9	26.3	16.6	26.0	24	33	44	48	.873
4	3	5.9	22.6	14.8	56.1	48	52	60	60	1.032
5	9.6	21.7	26.5	16.2	24.4	24	32	40	46	.904
6	11.0	19.5	25.7	15.5	25.8	27	35	40	44	.927
7	12.4	24.9	25.1	15.3	19.3	28	32	39	43	.933
8	11.4	24.6	25.8	13.2	24.7	27	33	39	44	.947
9	8.8	19.9	23.8	13.8	28.1	28	34	42	42	.927
10	8.8	15.8	22.3	15.9	34.7	26	34	43	48	.994
11	10.9	22.2	24.7	15.8	23.9	27	34	41	47	.958
12	12.5	21.8	25.5	16.0	22.8	27	32	40	45	.966
13	8.2	19.1	24.4	15.8	29.8	28	36	43	42	.924

* Colors of crude oils designated as follows: Blackish black—B.B.; green oil brown—G.B.; brownish green—B.G.
** Approximate.

Wizard Lake, and both D-2 and D-3 zones from Leduc have low sulfur contents. The oils range in gravity from 40.9° for the sample of D-3 zone production from Leduc to 30.2° for the sample from Stettler.

Tables 2, 3, and 4 are complete routine analyses of oils from Campbell, Leduc (D-3), and Stettler (D-2), respectively.

Comparison of correlation-index (C.I.) curves for four Alberta oils and East Texas are shown in Fig. 2. Previous articles in this series[1-3] explained the use of C.I. curves in comparing specific gravity-boiling range characteristics of distillate fractions obtained during the routine analysis. C.I. curves for the four Alberta oils shown were selected because they represent the extremes. C.I. curves for the other Alberta oils fall within the pattern shown in Fig. 2. The distillates are markedly similar, except for those from Stettler and Big Valley (D-3) oils.

Comparison with Mid-Continent Crude

The oils compare favorably with good-quality Mid-Continent crude oils of similar gravity, except those from Big Valley (D-2), Redwater (D-3), and Stettler (D-2) fields. These three crude oils have a higher sulfur con-

Table 2—Routine Analysis of Crude Oil from Campbell Field, Alberta, Canada

Identification

Sample 51068
Campbell field
Beaverhill Lake, Lower Devonian
Well 6-20-46-19
Alberta, Canada
14-25-W. 4th Meridian

General Characteristics

Gravity, °API 40.0
Pour point, °F −5
Color Greenish black
Viscosity, S.S.U. at 100° F. 60
Sulfur, wt. % 0.90
Nitrogen, wt. % 0.03
Carbon residue, wt. % 2.7
Ash, wt. % 0.01
Vanadium, p.p.m. 0.0
Neutralization No., mg. KOH/g. 0.10

Distillation, Bureau of Mines Routine Method

Stage 1—Distillation at atmospheric pressure. Tar sand cut.
Final temp. 572° C. (1060° F.)

Fraction No.	Cut at—° C.	° F.	Vol. %	Sum, %	Sp. gr. 60/60° F.	°API 60° F.	C.I.	Aniline point, ° C.	S.U. vis. 100° F.	4-load test ° F.
1	50	122	1.2	1.2						
2	75	167	1.8	3.0	0.662	81.3				
3	100	212	3.4	6.4	.721	64.6	15	52.0		
4	125	257	6.0	12.4	.746	58.5	20	58.0		
5	150	302	6.3	18.7	.766	53.2	27	60.2		
6	175	347	5.7	24.4	.785	49.1	29	59.6		
7	200	392	4.7	29.1	.802	44.9	31	61.0		
8	225	437	5.1	34.2	.815	42.1	34	59.4		
9	250	482	5.5	39.7	.829	38.8	32	62.1		
10	275	527	6.4	46.1	.845	36.0	37	65.9		
Stage 2—Distillation continued at 40 mm. Hg.										
11	200	392	3.3	49.4	0.859	33.4	32	70.8	43	16
12	225	437	4.0	53.4	.868	31.6	35	74.0	46	21
13	250	482	3.2	60.6	.884	28.6	42		60	43
14	275	527	5.1	65.9	.894	26.8	44		68	65
15	300	572	6.3	72.2	.905	24.9	46		120	80
Residuum			26.5	98.7	.973					
Carbon residue of residuum, 3.1 per cent; carbon residue of crude, 2.7 per cent.										

Approximate Summary

	%	Sp. gr.	°API	Viscosity
Light gasoline	7.4	0.655	77.2	
Total gasoline and naphtha	29.1	0.734	60.2	
Kerosine distillate	5.1	.815	42.1	
Gas oil	14.3	.847	35.6	
Nonviscous lubricating distillate	10.4	.869-.893	31.3-26.9	50-100
Medium lubricating distillate	8.2	.893-.905	26.9-24.9	100-200
Viscous lubricating distillate	1.9	.905-.911	24.9-23.9	Above 200
Residuum	26.5	.973	13.7	
Distillation loss	1.1			

Table 3—Routine Analysis of Crude Oil from Leduc Field, Alberta Canada

Table 4—Routine Analysis of Crude Oil from Stettler Field, Alberta, Canada

tent, and the distillation residuum is more asphaltic.

Properties of gasolines prepared from Leduc and Redwater oils and Diesel fuels from the same oils are shown in Tables 5 and 6, respectively. The gasolines compare favorably with products from high-grade crude oil produced in the Mid-Continent area, except for their content of mercaptan sulfur, as indicated by a sour reaction to the doctor test. However, the sulfur content is not high and could be reduced to satisfactory limits with very little treating.

The Diesel fuels also compare favorably with similar products from high-grade crude oils from the Mid-Continent area.

Utilization Possibilities

Only those products whose characteristics are given in Tables 5 and 6 were prepared and tested for quality. However, indications of the quantity and quality of other and similar products from other Canadian crude oils may be obtained with a fair degree of accuracy from the routine analysis.

Aviation base stock: Both the octane numbers of the two gasolines prepared from Leduc and Redwater crude oils and the low C.I. values of fraction 4 for all the Alberta oils indicate that a negligible yield of aviation base stock could be expected.

Motor gasoline: Good-quality gasoline (400° F. E.P.) may be obtained from both Leduc and Redwater, as indicated by the data in Table 5. The yield for Leduc (37.3%) is the highest to be expected from any of the oils, although the expected yields from Big Valley (D-2) and Stettler (the oils from which the lowest yield would be expected) approximate 25.

Kerosine: Yields of 5 to 10% kerosine can be obtained from the oils. The sulfur content of several would be high, and considerable sulfur reduction would be necessary. Calculations based on refractive index data indicate that the aromatic content would be approximately 15%, which is high enough to justify an expression of doubt regarding their satisfactory burning quality.

Diesel fuel: The yield and quality of Diesel fuels from all of the crude oils should be comparable to those for which data are given in Table 6. Variations of approximately 5% yield can be expected. Data from the routine analyses indicate that gas oil from the Stettler crude oil is the most naphthenic of the oils represented, and correspondingly Diesel fuel from Stettler would be expected to have the lowest cetane number. The value should approach 50, however, as the difference is not great.

Fuel oil: Both distillates and re-

sidual fuels comparable in quality and yield to those obtained from high quality Mid-Continent oils could be prepared from all of the oils.

Jet-engine fuel: Yields of from 8 to 12% of JP-4 fuel and from 35 to 45% of JP-3 fuel could be expected from the oils. The freezing points of both fuels would be expected to be too high for present specifications (−76° F.) if the maximum yields given above are obtained.

Lubricating oils: Lubricating stock of fair quality could be made from Canadian crude oil with conventional dewaxing processes. However, on the basis of the routine analysis they do not compare favorably in this respect to the better grades of Mid-Continent crude oil, such as Burbank and Oklahoma City. The potential lubricating distillate from the Canadian crude oils is more naphthenic than comparable material from the two Mid-Continent oils mentioned and a lower viscosity-index product would be expected after treatment.

Asphalts: Using the method described in previous articles of this series [1], the content of 100-penetration asphalt obtainable from the Canadian oils studied varies from approximately 25% for Stettler crude oil to approximately 7% for Leduc (both D-2 and D-3), Golden Spike and Wizard Lake.

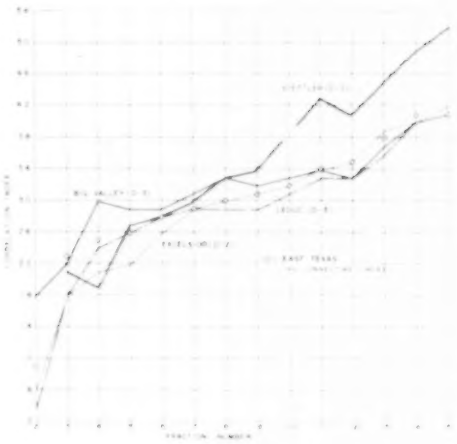


FIG. 2 Correlation index curves of crude oil from Alberta, Canada, compared to U. S. data of East Texas crude.

Table 5—Properties of Approximate 400 F. E.P. Gasoline from Crude Oils from Leduc and Redwater Fields

	Leduc (D-2)	Redwater (D-3)
Yield, % of crude	12.0	10.4
Gravity, °API	57.6	57.6
Sulfur, wt %	0.03	0.03
Reid vapor pressure, lb.	11.5	11.0
Aniline gravity	113	113
Distillation, ASTM D86, Temp., °F. (Corrected)		
I.B.P.	96	91
5	112	111
10	122	120
20	136	135
30	148	146
40	161	161
50	177	177
60	192	191
70	208	204
80	224	221
90	244	241
95	260	264
99	294	294
E.P.	310	310
Octane No., ASTM D357, Motor	76.0	76.0
Vapor lock index	1410	1410
Clear octane number	74.0	74.0

Table 6—Properties of Diesel Fuel from Leduc and Redwater Fields

	Leduc (D-2)	Redwater (D-3)
Yield, % of crude	12.0	9.0
Gravity, specific	0.841	0.841
Gravity, °API	36.5	36.5
Sulfur, wt %	0.27	0.32
Cetane No. (D-613)		
5 vol. % at 250° F.	Neg.	Neg.
Aniline point, °F.	160	160
Pour point, °F.	0.0	0.0
Distillation analysis, ASTM D86		
Appearance, vol. %	10.0	10.0
Gasoline, vol. %	2.0	3.0
Flash point, ASTM D93, °F.	150	150
Cloud point, ASTM D97, °F.	0	0
Pour point, ASTM D97, °F.	0	0
Viscosity, ASTM D445, at 100° F.	2.04	2.06
Furfural No., ASTM D1611	0.0	0.0
Distillation, ASTM D158, Temp., °F. (Corrected)		
I.B.P.	420	410
5	441	432
10	458	451
20	478	472
30	496	492
40	514	510
50	532	532
60	550	558
70	568	588
80	588	618
90	624	652
E.P.	662	690

Acknowledgments

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References

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How to Evaluate Lube Oil Additives

By M. A. HUGHES and E. C. HUGHES
Chemical and Physical Research Division, Standard Oil Co. (Ohio)

A laboratory motor oil oxidation test, developed to obtain significant information on performance in severe engine operation such as the L-4 test, has been used to advantage in evaluating some 47 commercial additives which are said to protect against deterioration in such service.

An investigation by Standard Oil Co. (Ohio) was aimed at comparing the additives by the oxidation test so as to 1) select the best of the group for consideration in engine tests and 2) understand performance as related to the products' composition.

The procedure known as the Polyveriform[1] lube oil oxidation test, has already been described by Hughes, Barbieon and Stanley.[2] A brief description of the apparatus appears on page 1279.

The ten best additives were selected based on a combination of economic and technical factors. All except one contain metal, sulfur and phosphorus. All, except the one, are known to give good performance in the L-4 engine test. However, the quality of Polyveriform results vs. costs of the additives as shown in this study indicates that selecting the best ones of the group may effect a saving of as much as 20-50%.

Correlations of the Polyveriform test with the L-4 test are as yet not good enough to *guarantee* such results. It is recognized that laboratory tests can never take the place of final decisions now reserved for the engine. However, results of the investigation have been good enough to warrant the projection of an engine study of the additives selected to see if savings can be made in oil formulations. Results of a recently conducted correlation between L-4 and Polyveriform are given later in this article.

A typical solvent-extracted oil, such as is now almost universally

Table 1—Source and Properties of Base Oil

Crude source	Mid-continent
Refining	Solvent extraction, followed by MEK dewaxing and sulfuric acid treating
Viscosity, Saybolt Universal, 100° F.	210
Viscosity, Saybolt Universal, 210° F.	47
Viscosity index	101
Color, ASTM	2
Flash point, °F.	395
Fire point, °F.	445

Table 2—Chemical Analyses and Costs of Commercial Additives

Number	Type	Chem. Anal., Percentages: Ash	S	P	Metals	Ratio: % Ash / % S	% Conc. Recom.	Cost, $ gal., T. C. Loads
1	Oxidation Inhibitor	0.0	0.1	0.0		0	1.0	$1.70
2	Detergent	0.8	0.1	0.1	Ba 0.0	1.00	0.5	1.65
3	Detergent-inhibitor	2.1	2.2	1.0		1.05	2.5	2.20
4	Detergent-Antiwear	2.1	1.1		Ba 0.0	2.00	2.5-3.5	2.40
5	Oxidation Inhibitor	1.1	3.0	1.05	Zn 1.20	0.37	2	1.95
6	Oxidation Inhibitor	1.1	3.1	1.00	Ca 0.05 Zn 1.02 Ca 0.02	0.35	1.5-1.25	1.82
7	Oxidation Inhibitor	1.1	3.1	0.95	Zn 1.05 Ca 0.02	0.35	1	1.44
8	Oxidation Inhibitor	1.1	3.1	0.95	Zn 1.10 Ca 0.02	0.35	1	1.25
9	Detergent	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
10	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
11	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
12	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
13	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
14	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
15	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
16	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
17	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
18	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
19	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
20	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
21	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
22	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
23	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
24	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
25	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
26	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
27	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
28	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
29	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
30	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
31	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
32	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
33	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
34	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
35	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
36	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
37	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
38	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
39	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
40	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
41	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
42	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
43	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
44	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
45	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
46	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50
47	Detergent-inhibitor	1.1	0.1	0.0	Ca 1.10	1.10	1	1.50

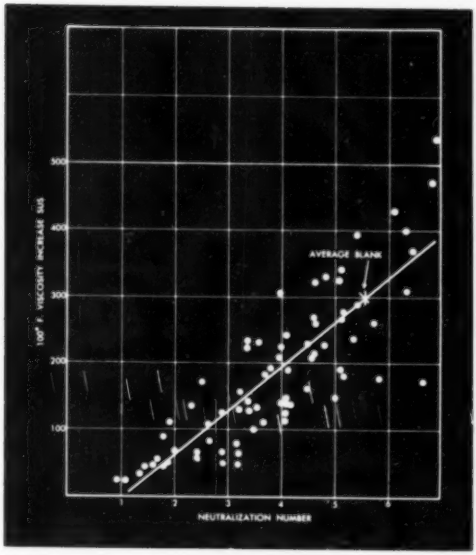


FIG. 1 Relation of viscosity increase to neutralization number in oxidized oils

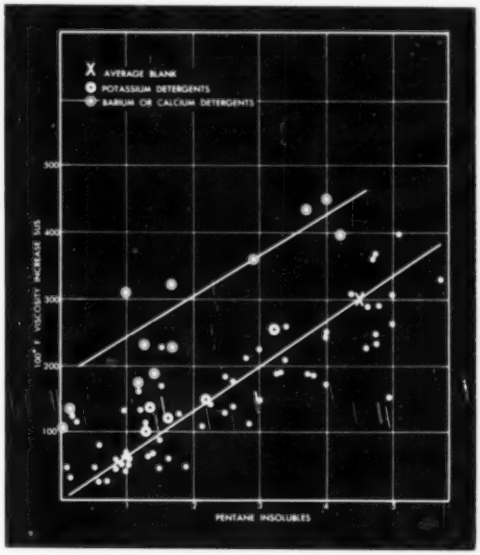


FIG. 2 Relation of viscosity increase to % pentane-insolubles in oxidized oils

used for the higher quality oils, was chosen as the standard base stock in which all the inhibitors were to be tried. Its source and common properties are shown in Table 1. In engine operation, it is known that such a base oil, uninhibited, will give certain trouble which is to be overcome by the inhibitors. One of the worst of these is a tendency to corrode alloy bearings such as those made of copper and lead. Another difficulty is that the viscosity will increase, even as much as doubling.

Unlike the older acid-refined oils, the solvent-extracted base oil in service does not deteriorate in such a way as to cause deposit in the engines unless it is operated under even more severe conditions or for longer periods than will cause the above changes. However, the extent to which it might cause deposits is indicated at an earlier stage by the presence of pentane-insoluble but oil-soluble, molecules. These later become oil-insoluble, precipitating out and fouling the engine.

The test procedure chosen was:

Time	10 hrs.
Temperature	325° F.
Air Rate	70 liters hr
Metals	4.4 cm² Cu-Pb
Catalysts	
0.05% Fe_2O_3; 0.10% $PbBr_2$	

The base oil was run repeatedly in the test during the course of the work. Reproducibility was good, and the average results were:

Cu-Pb. corrosion	15 mg.
Viscosity increase, S.U.S.	350
% Pentane insolubles	4.0
Neutralization number	5.4
Lacquer rating	A
Sludge rating	A

No oil-insoluble products were formed during the test period, as shown by the perfect "A" ratings for sludge and varnish. It is known from other work that if the test on this type of oil were extended to 20 hrs., considerable deposits would form. The copper-lead test piece was corroded to the extent of 15 mgs. The above reference shows that this is a serious amount and that such an oil in engine service would corrode copper lead bearings.

Additives Selected

Thirty-three preparations which are sold as oil additives were compared with each other as to the results in this test. In addition, several nitrogen-containing gasoline and hydraulic oil inhibitors were tested. Table 2 shows the available information on these products.

All the additives recommended for oil are shown to contain substantial amounts of sulfur, presumably chemically bound. The only exception is the metal phenate + dibutyl para cresol combination. The other element common to the oil additives containing sulfur is phosphorus. This is found in all but two of such additives whose analyses are shown. These two are stated to be only detergents. Thus, it appears that probably phosphorus pentasulfide is universally used to introduce the inhibiting sulfur into the organic part of the inhibitor.

Of the 33 strictly oil additives tested, only three did not contain metal. In fact, in 25 cases in which both sulfur and metal analyses are available, 17 have a ratio of ash to sulfur greater than 1, as shown in the seventh column of Table 3. The metal contents are highly variable, the highest being the 18.2% of No. 26, and the lowest being the 2%'s of the oil-diluted additives. There are 5 additives of noticeably higher ash-to-sulfur ratio than the others. These are called detergents by the manufacturers. These are Nos. 2, 4, 13 (obsolete), 12, 17, and 26. While these were tested alone in this test, it should be remembered that the manufacturer recommended they be combined with a straight oxidation inhibitor in an oil formulation. Nos. 17 through 21 contained potassium as the metal and they were unique in this regard except for No. 33. Barium, zinc, and calcium were the other metals used.

Polyveriform Testing

The additives were first tested in the oils at the manufacturers' recommended concentration. If they were very good, a test was then made at lower concentration and vice versa. The results are shown in Table 3. Each manufacturer's products are grouped together with the one giving

the best result at the top. The actual results of the tests are shown here along with summary ratings.

The summary number system emphasizes those properties which change with the uninhibited base oil, namely, Cu-Pb corrosion, viscosity increase, % pentane insolubles, and neutralization No. This system is called "per cent of perfect" and since it will be used mostly in our thinking, the steps in its evolution will be detailed.

In Fig. 1, the viscosity increase is related to the neutralization No. A surprising degree of correlation is shown. Since the correlation is so good, viscosity increase was taken

Table 3—Test Performance and Comparative Ratings of Commercial Additives

Number	% Conc. Used	% S in Sample	Results of Polyveriform Test: Cu-Pb Corros.	Vis. Inc. %	% Pentane Insol.	Neut. No.	Lacquer	Sludge	Demerit Rating	% of Perfect
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

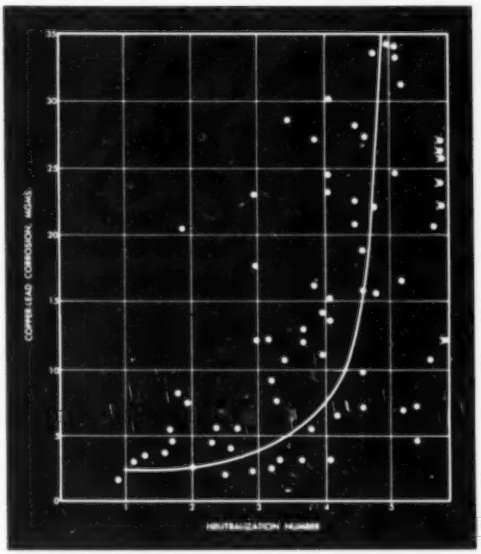


FIG. 3 Relation of neutralization number to corrosion of Cu-Pb test pieces

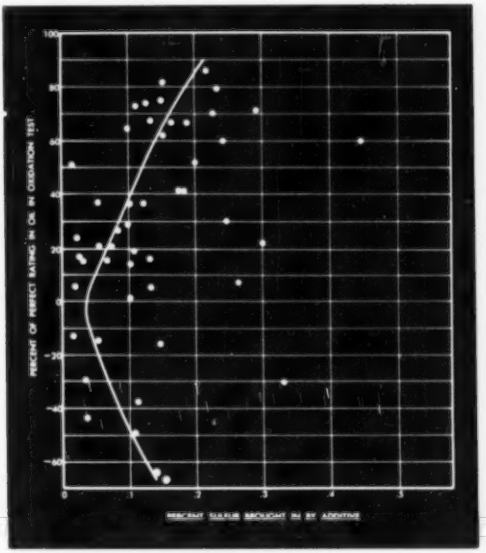


FIG. 4 Relation of inhibition to % sulfur brought in by additive

into the "per cent of perfect" formula and neutralization No. was left out.

In Fig. 2, the viscosity increase is related to the pentane insolubles. Here the correlation is much poorer although two lines will describe a large majority of the points. Therefore, the pentane insolubles were included in the formula.

An attempt was made to relate viscosity increase to Cu-Pb corrosion without success.

Fig. 3 shows a non-linear relation between neutralization No. and corrosion. Since the neutralization No. is not in the formula, it is essential that corrosion be in. The formula was then developed as follows:

$$100 - \left[\frac{100}{3}\left\{\frac{\text{viscosity increase}}{\text{vis. inc. of blank}} + \frac{\%\text{ pentane insolubles}}{\%\text{ pent. ins. on blank}} + \frac{\text{Cu-Pb corrosion}}{\text{Cu-Pb corr. of blank}}\right\}\right] = \%\text{ of perfect}$$

In this way, no change at all in each variable would be 100% perfect. In each case the blank is zero on the scale.

A total of 47 additives was tested. Of these, 20 had a "per cent of perfect" rating of 59% or over. These 20 were the important ones for further evaluation and so they are resummarized in Table 4.

There are representatives from each of the ten manufacturers in this table. It is questionable as to whether the optimum concentration of the better additives rating below 80% perfect was used. Therefore, careful consideration should be given to all above 59%. One reason for using care in this way is the very rapid change in quality that small changes in concentration can produce. Thus, for example in Table 4, No. 11 is a good case in point. One per cent was enough to give a 20% of perfect rating. Now 2% gave a 73% of perfect and 0.7% raised this way up to 82% at which point there was very little change or corrosion occurring.

In order, however, to make comparisons in such a way as to narrow the field down still further for later engine work, the factor of economics is brought to play. In Table 2, the summer of 1950 prices per gallon of the additives is shown. The last two columns of Table 4 show the costs of inhibiting the oil in the tests that have good results and also a "factor". This "factor" is simply obtained by dividing the cost of inhibiting by the per cent of perfect rating times ten. It is then the cost of obtaining each 10% of improvement in the critical range above 59% of perfect. Table 4 has been arranged in descending order of this cost factor.

There is a wide variety in the costs of inhibition, as shown in this table, ranging from 1.73 to 10.4¢ gal. for the sulfur types. While this is true for the "factor" also, yet the first ten additives in this table range but from 0.4 cent per 10% of improvement plus or minus 0.15.

These should, therefore, be the ones given the most engine study. For example, a company now using No. 26 might find it advantageous to use No. 14 or No. 16, if an engine study bore out the findings of this report. If so, the costs might be reduced by 20 to 50% of the present costs.

While both the Du Pont 5T and 22 made the first 20 list, and had a high degree of perfection in restraining oxidation, it is not believed possible to use them because of an instability toward heat. This would be true of the metal deactivator which also showed up well in this test. In the Polyvoltam procedure used here, all the catalysts were brought into the tests at the start. If chelation or other reaction could occur with the inhibitor, then the result would be good. However, in the engines the catalysts came in slowly during the run due to wear. Thus, the inhibitor has a chance to be destroyed before it reacts.

An unusual additive which rated high was the alkaline metal-phenate-dibutyl para cresol combination. We do not know how it behaves toward the heat condition of the engine test; it should be engine-evaluated.

Inhibiting Value Related to Composition

Fig. 2 shows a series of points which have been encircled to show that they were made by additives which were supposed to be high in

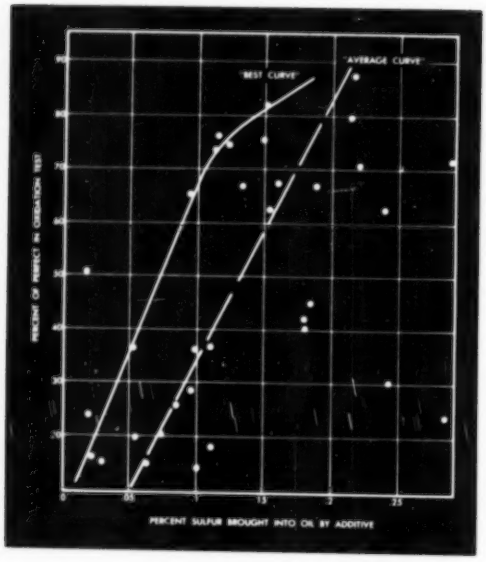


FIG. 5—Detail of section of graph in Fig. 4

detergency. It will be noted that all of them cluster around the upper line and thus show less naphtha insolubles than would be predicted from their viscosity increase. While this observation is true for the alkaline earth metal derivatives, it is not true for the additives containing potassium as the metal.

Fig. 4 shows that a fair relationship exists between the amount of sulfur brought in by the additive and its inhibiting value. This is magnified in Fig. 5 covering the additives that did not cause worse results than the base oil. While a trend is obviously significant there is sufficient scattering of points to show that all sulfur is not the same from additive to additive. This was emphasized by the one pure compound tested, phenyl polysulfide, which gave results worse than the base oil.

In Fig. 5 a "best" tabulation of sulfur curve is shown. Nos. 11, 16, 17, 11, and 18 are on this curve. Despite neutralized additives (low ratio of ash sulfur) such as Nos. 19, 21, and 6 seem to have a lot of "poor sulfur" in them. Additives Nos. 32 and 34 lead toward this class, bringing in more sulfur than one would expect from the inhibition obtained.

Attempts to correlate % phosphorus and % ash with the inhibiting result showed only scatter so that it was probable that the important element was sulfur in most of these.

One remarkable result of these studies was the frequency with which inadequate amounts of inhibitor would cause worse results than the uninhibited oil. Two examples are near the top of Table 3 in Nos. 9 and 10. Many other examples will be observed in this table. This emphasizes the necessity of accurate blending control or a company might well find itself putting out part of its oil actually worse than if it had never tried to inhibit. The Polyverform test and similar tests should find considerable use for this purpose.

Recently, tests were run independently by two Sohio laboratories as well as an additive manufacturer. They have shown very good correlation, on an overall basis, between L-4 and Polyverform. The additive was used at four levels of concentration in the Polyverform test and three in the L-4. Summarized results, averages from the three independent runs, follow:

Conc. in oil	Demerit Rating by L-4	% of Perfect by Polyver.
0.4%	6.8	36.0
0.7%	4.9	43.0
1.0%	3.9	50.0
1.3%	2.5*	69.8

* Extrapolated

Conclusions

1. The ten best additives have been selected from the 47 tested as being worth engine testing to see which will give the most economical inhibition of light motor oil. See Table 4.

2. All but one of these is characterized by having sulfur, phosphorus, and an alkaline metal. The exception is a phenolate-cresol.

3. It is shown that sulfur is the important element in these combinations but that its result is enhanced by a proper balance of the metal.

4. Among the good additives there is a possibility of as much as a 50% saving on inhibitor cost by using the one best fitted to the oil. (What the engine will show *must* be studied to make final deductions as this study does *not* claim sufficient correlatability with engine to substitute it.)

5. The increase in viscosity during the test correlated very well with the increase in neutralization No.

6. Many additives were observed to give results worse than the blank when insufficient concentration was used.

Acknowledgments

For their assistance on this project we are grateful to Dr. John D. Bartleson, Margaret Sunday, Harvey Alford, Virginia S. Masson, and Richard Harris.

Reference

1. Boyer, Clarence: Test for Lubricating Oils, E. V. Higgins, J. D. Bartleson, and M. J. Murphy, Standard Oil Development Co., Ind. & Eng. Chem., Anal. Ed., 1937, p. 257.

Table 4—Summary of Best Inhibitors at Better Concentration

Number	Conc. Used	% of Perfect	Costs of Inhib. oil to give Observed Result* c/gal.	Cost of Inhib., c per 10% of Improvement
[illegible]	[illegible]	58	3.75	0.262
[illegible]	[illegible]	54.5	2.56	0.281
[illegible]	[illegible]	74	2.56	0.344
[illegible]	[illegible]	74	[illegible]	0.411
[illegible]	[illegible]	58	[illegible]	.425
[illegible]	[illegible]	60	2.56	0.341
[illegible]	[illegible]	52	3.66	0.474
[illegible]	[illegible]	58.5	3.41	0.455
[illegible]	[illegible]	54	3.42	0.56
[illegible]	[illegible]	50	3.42	.57
[illegible]	[illegible]	75	4.66	0.66
[illegible]	[illegible]	64	6.1	0.78
[illegible]	[illegible]	64	6.1	1.0
[illegible]	[illegible]	62	10.1	1.2
[illegible]	[illegible]	70	7.5	1.27
[illegible]	[illegible]	60	7.5	1.26
[illegible]	[illegible]	70	7.4	1.42
[illegible]	[illegible]	60	7.5	2.15
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	60	[illegible]	[illegible]

How the Lube Oil Test Unit Works

THE Polyvariform lubricating oil test unit was developed co-operatively by Standard Oil Co. (Ohio) and Precision Scientific Co. Designed to serve as a pilot tester in selecting lubricants quickly for further and more complete analysis under full-scale procedures, it is useful in the study of oxidation stability, varnish and sludge formation, and corrosion characteristics.

As shown in the illustrations of the commercial unit the instrument will handle 12 tests at one time. In operation, a highly polished test piece of bearing metal is weighed and placed in 100 gm. of oil sample in each Pyrex tube unit. A thrust load of 600 gm. is placed on the test specimen disc through the test specimen rod to approximate the thrust load on an engine bearing.

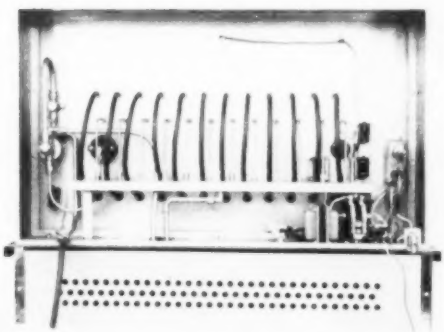
The entire test set-up is heated to and held at 325° F. by a thermostat. The test specimen rod is then rotated at 625 rpm. on the test specimen disc while air is bubbled through the oil sample at 70 liters/hr. Before and after the run, the usual test for pentane-insolubles, benzene-insolubles, viscosity changes, neutralization number, and saponification are made on the subject oil. The bearing metal piece is weighed after the test to determine the degree of corrosion.

Uses Hydraulic Thermostat

All operating controls are mounted on the instrument panel and illuminated by fluorescent light. The aluminum block bath has insulation of 2-in. glass wool on six sides. It is fitted with a hydraulic thermostat to control the bath from room temperature to 325° F. Three, 500-watt, strip heaters, 1½ in. wide, provide intermittent heat. Two additional heaters are used as auxiliaries.

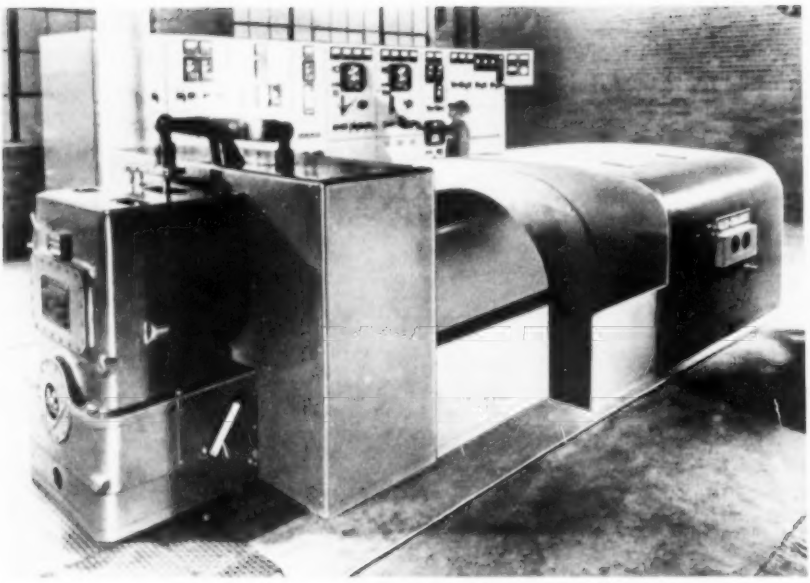
Test spindles are driven in sets of six each by the two ¼ hp. ball-bearing motors. Air is introduced into the Pyrex test tube through Pyrex glass tubing. Flowrators, variable-area flowmeters, fitted with integral needle valves, govern the air flow rate to each unit, and are mounted on the instrument panel. The air train has four traps for cleaning and drying the air. Traps are all-glass, air-washing bottles connected to individual bubblers with rubber tubing. A pressure gage and regulator are installed in the air line.

SOHIO-DEVELOPED LUBE OIL TEST UNIT handles 12 tests at one time. All operating controls are on back panel.



BACK OF PANEL, showing controls and tube connections.

DETAILS OF PARTS of an individual test unit tube.



A TYPICAL STEAM TURBINE-GENERATOR installation. NEMA standard, non-condensing

How to Power the Refinery

High thermal efficiency can be obtained by having proper balance between process steam and power

By C. W. BLOEDORN
Steam Turbine Section
Allis-Chalmers Mfg. Co.

CONSIDERABLE electric power, as well as a large quantity of process steam, is used in oil refineries. Because of the large amount of process steam used, refineries always have been a large user of steam for drives not only for driving generators but for driving other mechanical equipment in the plant as well. In recent years the size of turbines used and the operating pressures and temperatures have increased.

Thus the power plant is not only used to produce electric power at the lowest possible cost and without variation in frequency, but must supply the necessary large amount of steam for the processes at required pressure and temperature.

Electric power should be a by-product of any industrial plant's steam operation for economy. That is, the steam should be generated at a pressure and temperature higher than the process requirements and then pass through the turbines to generate electric power before being extracted or exhausted to the process steam lines.

In considering the relative advantages of purchased power versus generated power, the cost per kilowatt usually is the main consideration along with the base gage of steam demand. Moreover, initial investment, space requirements and availability of skilled personnel also are important factors.

Some refineries have found it economical to generate low pressure steam for process and purchase all of their power requirements. In fact, some refineries purchase not only power, but also the required process steam from a neighboring utility company. They have found that the power company is in a position to provide excellent service at a reasonable cost.

Other refineries economically generate some of their power requirement as a by-product of their process steam demand but maintain a tieln with the utility company to insure a dependable source of power at a lower cost than essential standby equipment.

Still other refineries find it economical to generate all of their power requirements with no interconnection with a utility company.

In planning a power plant, the refinery's needs must first be studied. Each power plant must be considered on its individual merits, because each refinery has different requirements for steam and electricity. In order for an installation to be economically successful, the plant heat balance and power generating equipment must be coordinated so that the power demand can be met insofar as possible by generating byproduct power. This involves, among other factors, the proper selection of boiler pressure and temperature.

Savings can be made by using the proper type of steam turbine in a specific industrial plant. If the process steam and the electrical loads are balanced so that a non-condensing turbine can be used, the thermal efficiency of the installation, including boiler losses, will be about 75 to 80%, as compared with about 4% for the very efficient large central station.

High efficiency is attainable because credit is allowed for the useful heat in the exhaust. This credit is justified because the necessary heat to the process must be furnished whether the power is purchased from a utility company or generated in their own plant.

When steam is used to generate power alone with no requirement for process steam, approximately one-third of the heat in the steam is converted into useful power while the other two thirds of the heat is lost in the condenser circulating water. While in a few cases it has been possible to use the warmed-up circulating water in the process, it readily can be seen why it is economical to exhaust entirely to process, or bleed as much steam as possible from condensing automatic extraction turbines when their use is required.

A high thermal efficiency also can be obtained when non-condensing automatic extraction turbines are used. In these cases the exhaust steam as well as the extracted steam is used in the process. Therefore, the power cost will be very low whenever the power balance is such that "by-product power" can be produced by a non-condensing steam turbine (see Fig. 1), or a non-condensing automatic extraction turbine.

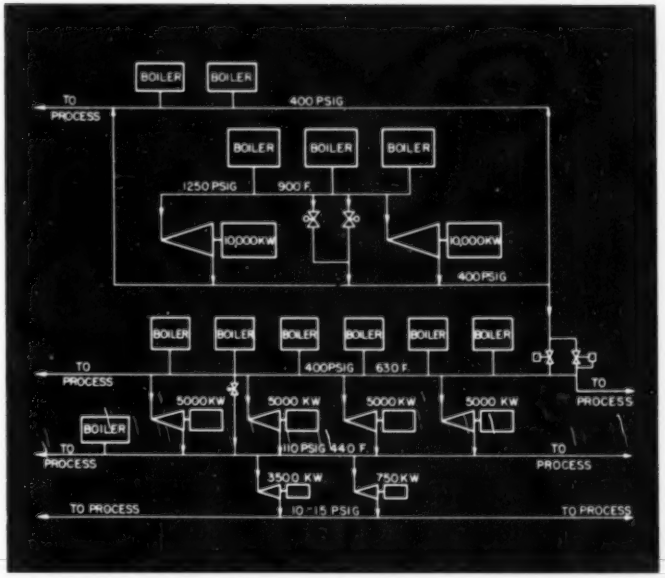
Turbines of this type are most practical when the process steam demand always exceeds that required to meet the electrical power demands. With this arrangement, steam over and above that required to generate the power demand is bypassed around the turbine and put through a reducing valve and desuperheater. Frequently, even under the most ideal heat balance arrangements, there will be times when the power load will be high and the process steam load will be low. Under these conditions, the deficiency in power must be either purchased from a utility company or produced from steam going to a condenser.

In the majority of cases, oil refineries have been able to use straight non-condensing turbines to generate power as a by-product of the process steam requirement. In fact, practically all of the steam turbines sold to oil refineries by the author's company, and there are a large number of them, have been of the non-condensing type.

In many plants the electrical load has increased more rapidly than the steam demand, necessitating an increase in throttle steam pressures and temperatures to obtain the necessary heat balance. The diagram at top of this page shows schematically the arrangement of steam turbine-generating units used in one large refinery to obtain the proper steam and power balance.

In this particular case, after a careful survey of plant conditions to determine the most economical arrangement for supplying process steam and power demands, it was found necessary to use throttle steam conditions of 1250 psig., 900 F.

Prior to the addition of the new high pressure turbine units, this plant had installed 20,000 kw. capacity in



STEAM AND POWER GENERATING equipment in a large refinery power plant

steam turbines operating with steam conditions of approximately 400 psig., 630 F. and 110 psig. back pressure, and 4250 kw. capacity in older turbines operating with steam at 110 psig. 440 F. and 10 psig. back pressure. The new 1250 psig. units are rated 10,000 kw. Certain processes in this plant now use steam at 400 psig. and, in addition, the exhaust steam from these high pressure turbines can be used in the lower pressure machines.

There are two reducing stations in parallel with these high pressure turbines supplying steam to the 400 psig. exhaust system. One of these valves is in operation at all times because the balance between kilowatt load and process steam demand is maintained by changing the amount of steam through these reducing stations and through other reducing valves between the 400 psig. and the 110 psig. system, into which the 400 psig. turbines exhaust.

When the 1200 psig. turbines were

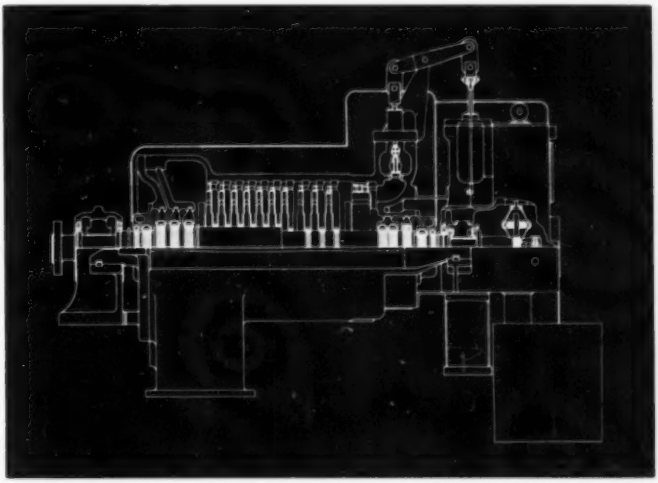


FIG. 1 Section of a non-condensing steam turbine

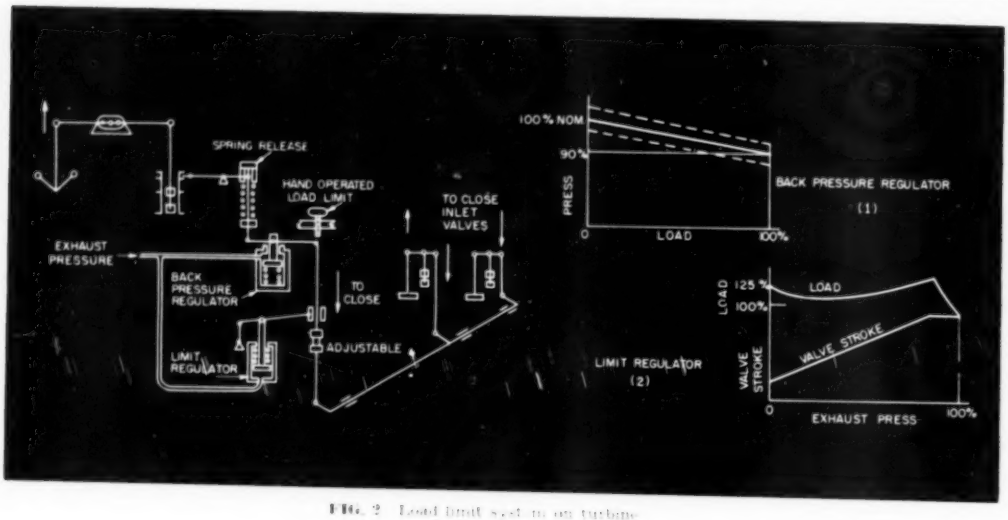


FIG. 2 Load limit set-up on turbine

installed, it was expected that the normal operation of the 400 psig and the 1200 psig turbines would be by means of manual speed changer control to distribute load between the turbines and maintain the speed of the system which has no ties to other sources of power. For this reason it was contemplated that back pressure regulators, supplied with the 10,000 kw turbines, would not be used until some future time when the heat balance would be such that the reducing stations normally would be closed.

Some unusual problems are encountered in the design and operation of high back pressure turbines of the size and type used in this refinery. During early discussions regarding the design of this 10,000 kw, 400 psig back pressure turbine, a question was raised regarding whether the turbine blades would withstand a sudden large drop in exhaust pressure.

It was pointed out that the blades could easily be made to withstand the additional stress imposed by this condition, but that if this condition did occur, the turbine because of the large steam chest capacity and the increased heat drop might develop twice the rated load and seriously overload the generator. While the generator could carry approximately 200% load without dropping out of synchronism, in one minute the generator temperatures would become excessive.

To prevent this condition, a device can be furnished which will limit the load on the generator, or maximum load relays can be installed to open the generator circuit. The load limit regulator would allow the turbine unit to supply electrical load and some of the steam requirements during the trouble period and permit a quick return to normal when the trouble has been isolated.

On the other hand, if maximum load relays are used and the generator circuit is opened, the turbine governor must close the inlet valves to hold the turbine at speed and the generator must be re-synchronized when the trouble is cleared. Therefore, it is desirable to have a device to prevent the load on the generator from reaching a value at which the generator breaker would open.

There are two causes for the decrease in back pressure: (1) if a 400 psig line were to break near the turbine, the drop in back pressure would be rapid and there would be no way to prevent a complete shutdown of the steam supply, the kilowatt load and the plant, and (2) if one of the 400 psig boilers were to be shut down suddenly, or if the reducing station supplying steam from the 1200 to the 400 psig header were to function incorrectly and close, or if a smaller line were to burst, the pressure would drop at a slower rate.

It was decided to equip the turbine

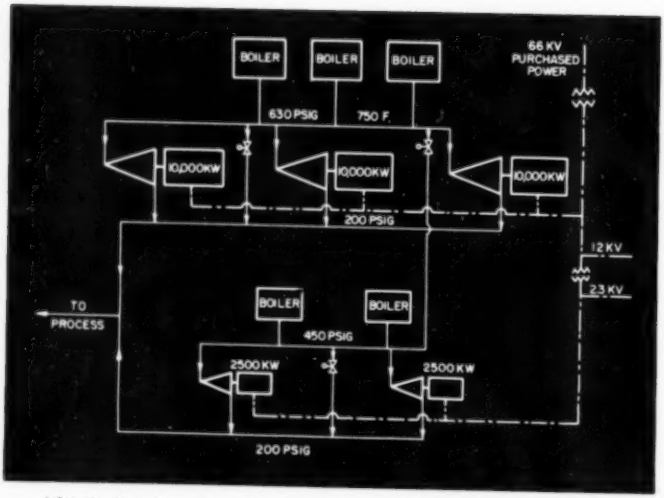


FIG. 3 Diagrammatic arrangement of power plant for an oil refinery

with a hydraulic pressure operated device which would respond to a back pressure below the normal range to close the turbine inlet valves by an action equivalent to manual operation of the normal load limit device. Fig. 2 shows the schematic arrangement of the load limit system furnished.

As an example of operation of the system, suppose that 100% load were being carried by the turbine with normal back pressure. The inlet valve position would be such that the load would increase to approximately 125% at a predetermined back pressure below normal. At this pressure the regulator would operate to close the inlet valves until the pressure was stabilized by the relation between the leak and other sources of steam supply.

The scale of the regulator is such that at the established back pressure below normal, the load will be approximately 125% of rated load. If partial load were being carried on the turbine and the back pressure were to drop below the predetermined value, the regulator will move to close the inlet valves, but would not contact the limit stop until the pressure dropped enough to increase the load to approximately 125%. This regulator can be made to operate the valves through the full stroke in approximately one second. This is much faster than any drop in pressure which can be stabilized by a limit system of this type.

Another refinery used non-condensing turbines to provide electric power and process steam requirements. In this case (see Fig. 3) it was found economically justifiable to tie in with the power company and purchase power at times when the electrical load exceeded that which could be generated as a by-product of the process steam demand. Also, the tie-in provides reliable standby service.

As shown in the illustration, the 10,000 kw. turbines, which are the newer units, are designed to operate with throttle steam conditions of 650 psig. and 750 F., while the smaller units are designed to operate with steam conditions of 450 psig. and 650 F. The exhaust pressure in each case is 200 psig. This plant is arranged so that at nearly all times some steam for process is by-passed around the turbines through a reducing valve and a desuperheating arrangement.

This refinery requested a regulation rate of 6% on the 10,000 kw. turbine governors for full load range, depending on hand setting by the governor speed changer motor to maintain the desired load on the machines. Since these turbine generators operate in parallel with the power company, the high regulation rate was selected so as to prevent excessive swings in load and to allow the governors to open the inlet valves if the tie line should open. The drop in speed would be corrected manually by the operator.

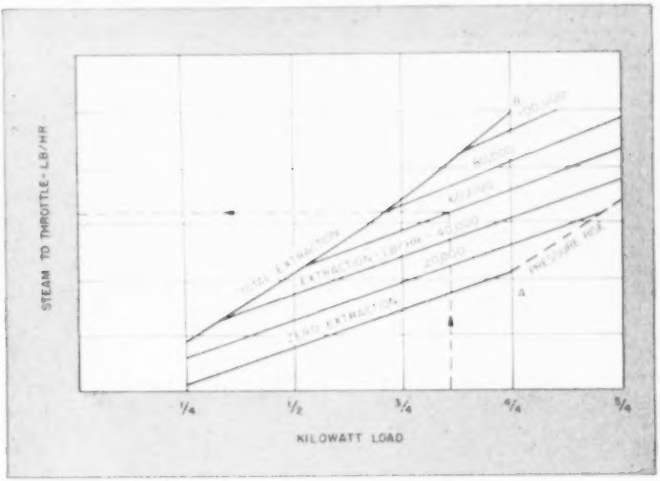


FIG. 4—Extraction performance chart

Here again, on these 10,000 kw. high back pressure, steam turbines, maximum load protection is provided to protect the generator in the event of a sudden drop in back pressure. In this case the means of protection is somewhat different from that previously described. For these steam turbine units the load limiting device consists of a power sensitive relay which, at a predetermined load on the generator, will close contacts in the turbine governor speed changer motor circuit. The speed changer motor then will operate to change the setting of the steam admission valves and reduce the load on the unit, whereupon the relay will automatically become inoperative and the speed changer motor contacts will open, permitting the governor to again assume normal control. This entire overload limiting device may be disconnected manually and, if desirable, may be arranged to close contacts for an alarm circuit when the speed changer motor is energized.

To cite another example of what can be done with non-condensing turbines; in one small industrial plant, where the power demand at times exceeded the amount that could be generated as a by-product of the process steam demand, it was found economical to operate a small non-condensing turbine in parallel with the power company and use a steam accumulator.

This turbine generator unit is equipped with a special regulator which operates in conjunction with the turbine governor speed changer motor in order to maintain any predetermined amount of power from the public utility tie-line. Under some conditions when the process or heating steam demand is low and the reducing station is not in use, the turbine operates under control of a back pressure regulator and exhausts excess steam into the accumulator. When the pressure in the accumulator builds up, the back pressure regulator acts to reduce the load on the turbine and the balance of power required is supplied by the utility. Under this condition, the tie-line regulator is out of service.

During the greater part of the time, however, the process steam demand exceeds the amount required to generate the necessary kilowatt load and the reducing station between the boiler and the process steam line is in use to supplement the steam supplied from the turbine exhaust. Here, the turbine back pressure regulator is locked out of service and the special tie-line regulator is adjusted to maintain the desired division between purchased and generated power.

Savings were made in this plant by having modern equipment tied in thermodynamically with a power-process arrangement, taking full advantage of the by-product possibilities and still maintaining flexibility of operation. Automatic operation, through the use of the tie-line regulator, back-pressure regulator, and automatic control on the reducing station, keeps operating costs at a minimum.

It has been the author's experience that the most applicable type of steam turbine for an oil refinery power plant is the straight noncondensing type and that it is practically

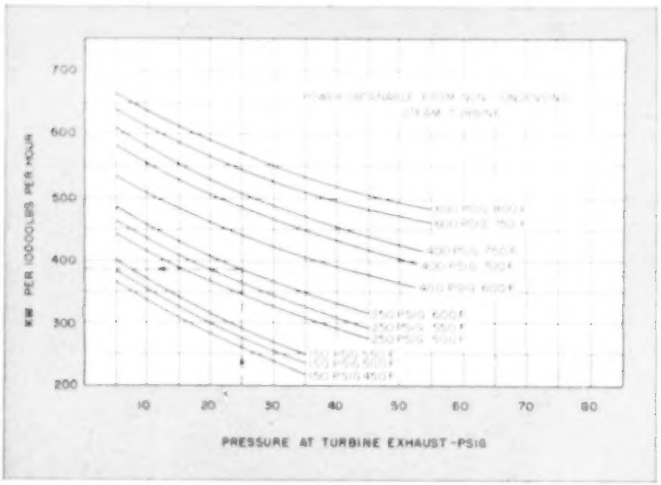


FIG. 5 Power obtainable from non-condensing steam turbine

impossible to justify the installation of a condensing type, either single or double extraction. However, since process steam frequently is required at more than one pressure, a non-condensing single automatic extraction type turbine might find its application in an oil refinery power plant.

This type of turbine can be arranged for automatic control of both the extraction and exhaust pressures, but then must be operated in parallel with some other source of power to control the frequency. The turbine then will pass only the amount of steam required to maintain the exhaust and extraction pressures up to the limit of the turbine steam passing capacity. However, the usual operation with this type of turbine is to automatically control only the extraction pressure under which condition it is not necessary to operate in parallel with some other source of power.

In order to stay within reasonable design standards, certain limitations are applied to the non-condensing single automatic extraction steam turbine. For instance, the ratio of initial pressure to extraction pressure (in psia.) should not be less than 1.75. Also, the ratio of extraction pressure to exhaust pressure should not be less than 1.75. The maximum design extraction flow should be an amount such that the flow ratio (ratio of maximum throttle flow to the full load zero extraction flow) does not exceed 4.0.

To illustrate what is meant by this flow ratio, refer to the extraction performance chart shown in Fig. 4. The ratio of the throttle steam flow at point *B* to the flow at point *A* should be less than 4.0. This type of chart, by the way, is a convenient, easily used method of expressing extraction turbine performance. A chart such as this not only can be used to obtain the necessary data for selecting the proper equipment initially, but also can be of assistance to the operator in determining economical loading and efficient division of load among several machines.

As a further explanation of the use of the extraction performance chart, if the operator knows the kilowatt load and process steam requirements at the extraction pressure, he can determine the throttle steam necessary to meet this condition by using the performance chart in the manner shown by the dashed lines. The flow to the exhaust, or low pressure process line, then, is equal to the throttle flow minus the extraction flow.

The proper turbine application often will pay for itself in a relatively short time, but an improper application can be a liability. Therefore, because constant improvements and new developments result in changes in industrial process steam and power demand, special turbine applications should be avoided unless the investment can be written off in a very short time. In anticipating possible future requirements, it should be remembered that up to two years or more may be required to place the power plant into operation after contracting for the equipment.

An industrial power engineer interested in the installation of a non-condensing steam turbine usually knows the amount of steam required for process and heating and the pressure at which it must be supplied. Therefore, he wants to determine the power that can be generated from this steam and, of course, this is related to the initial pressure and temperature. The initial temperature selected also will depend upon the temperature requirement of the process or the type of fittings or piping in the existing low pressure system.

Many recent oil refinery power plant installations have been of the high back pressure, or superimposed turbine type. To assist in making a power survey, curves such as shown in Figs. 5 and 6 can be used. The

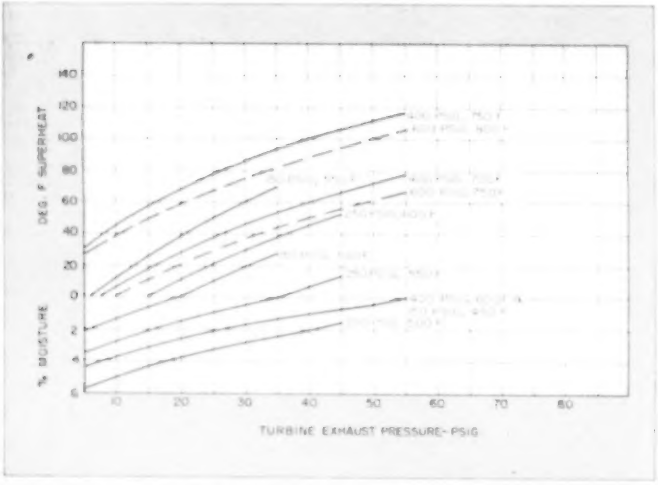


FIG. 6 Quality or superheat of steam at exhaust of non-condensing turbine for various steam conditions

curves in Fig. 5 give the approximate values of power obtainable per 10,000 lbs. of steam per hr. for various back pressures, throttle pressures, and temperatures. Fig. 6 gives the approximate quality or superheat of the exhaust steam for various steam conditions. These curves furnish reasonably accurate data for estimating purposes in the range of 7500 to 15,000 kw. inclusive. Similar curves can be provided to cover additional ratings.

Because of steadily increasing fuel costs, there is considerable interest in the savings in fuel consumption which can be obtained through the use of higher initial pressures and temperatures. In many cases also, the electrical demand has been rising more rapidly than the process steam demand, leading to a study of steam pressures and temperatures to give the proper balance between kw. load and steam load.

Gain in operating economy and desired power balance can be obtained by increasing steam pressures and temperatures above the 200 psig. classification which was quite common years ago. The chart in Fig. 7 shows the approximate percent improvement in steam rate for various initial steam conditions as compared with a base of 200 psig. 550 F. In each case the exhaust pressure is 10 psig.

It is quite possible that a study will show that a considerable gain in economy can be obtained through higher pressures and temperatures with only a small increase in initial investment. In practically every case in the oil refining industry the power-steam balance can be obtained with non-condensing turbines, thus eliminating the use of condensing equipment with its increased cost and concomitant loss in efficiency. The majority of recent installations have been in the 400 to 600 psig. classification with corresponding temperatures of 600 to 750 F. There have been a few exceptions where higher pressures and temperatures have been used.

Since the requirements for each plant are different and a survey is necessary to determine the proper economical equipment to install, the importance of keeping records can be realized. When a new power plant or an extension to an existing plant is contemplated, adequate records are essential so that an intelligent analysis can be made. Whether or not by-product power is being generated, the keeping of accurate records is important, not only so the refiner may know what he is getting for his money, but to enable the operator to determine the condition of the equipment.

With the records available, a study can be made to indicate how much of the electrical load can be generated as a by-product of the process steam load. Then, after determining the power generating equipment required to best meet the petroleum processing plant's conditions, an estimate of the savings effected can easily be made to decide whether the investment is justified. In some cases a net return of 20% or less can be justified, whereas in other cases this figure must be 40% or higher. (This percentage is the ratio of the estimated annual saving in the cost of fuel and power to the estimated total investment cost.)

Summarizing: Manufacturing processes change, high pressure steam is used where low pressure steam formerly was used, electrical loads increase faster than steam loads and present power facilities become inadequate resulting in increased production costs. These changes, then, may require a survey to determine how operating costs can be reduced, either through purchased power or with modern extraction type or non-condensing steam turbines. The needs of each plant must be analyzed individually in order to intelligently select the correct steam conditions and type of turbine to obtain the proper economic balance between power and process steam.

It is well to keep in mind, also, that the most desirable equipment for the user is that which will give him the maximum reliability with the minimum of operating expense. The lowest priced equipment is not always the most economical in the long run, so when purchasing equipment an analysis should be made giving consideration to factors such as performance, operating convenience, service facilities and features resulting in ease of maintenance, greater reliability and reduction in building construction costs.

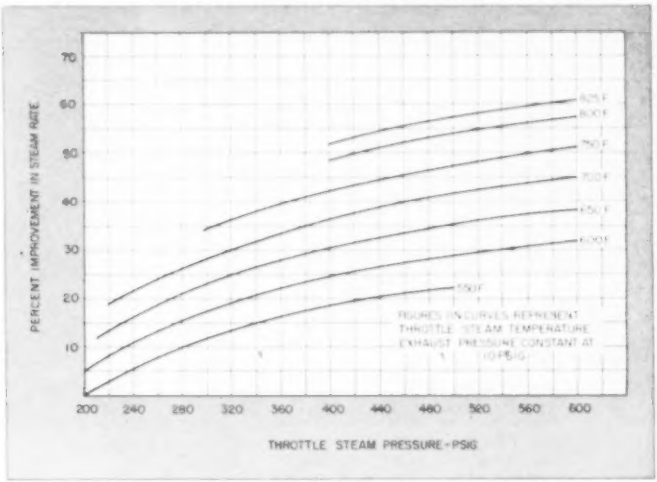
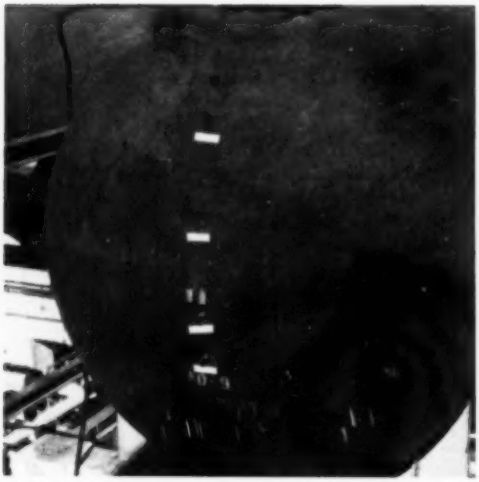


FIG. 7 Improvement in steam rate obtainable through use of higher throttle steam pressures and temperatures

Meet the Author

C. W. Bloedorn, steam turbine specialist for Allis-Chalmers Mfg. Co., is located in Atlanta, Ga. Prior to this assignment, he was supervisor of large steam turbine generator sales in the home office. A mechanical engineering graduate of the University of Wisconsin, Mr. Bloedorn became associated with Allis-Chalmers' steam turbine dept. in 1934. He is a member of the American Society of Mechanical Engineers and has authored many technical papers in the field of power generation.



RADIOACTIVE LEVEL INSTRUMENT on deflorinator feed surge tank. Detector is barely visible at top; radium sources on head marked by labels

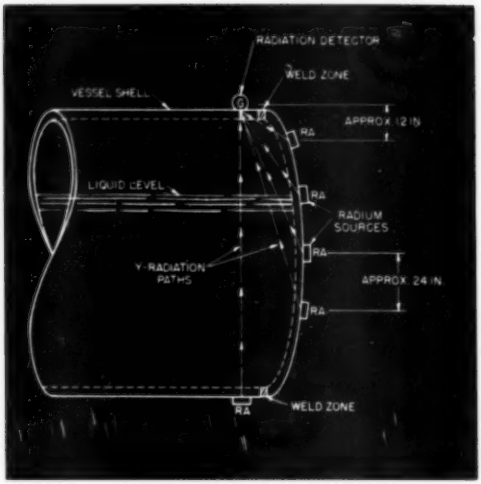


FIG. 1 Schematic diagram of Gagetron installation for liquid level measurement

"Hot Atoms" Measure Liquid Level

Radioactive type instrument useful on corrosive materials in process control on an HF alkylation unit

By D. P. THORNTON, Jr.
Southwestern Editor

TROUBLE-FREE measurement and control of liquid levels of corrosive streams has been a problem consuming the attention of design engineers specifying instrumentation for chemical plants. Phillips Petroleum Co. when recently rehabilitating the war-time HF Alkylation unit located at its Sweeny, Texas, refinery, took advantage of this opportunity to try out a new type liquid level controller, called a Gagetron, on processing equipment where failure of the instrument to perform as anticipated would not cause undue restrictions to the overall operation of the unit.

Phillips engineers feel that sufficient experience with this instrument has not yet accumulated to give a complete evaluation of the usefulness of the Gagetron for this type of service. However, preliminary indications are that the instrument will show that it has certain advantages which may make it useful in certain critical locations.

The Gagetron has the advantage of being externally mounted on the vessel, requiring no openings into the interior. It therefore is readily accessible for maintenance with a minimum of interference to the process. Since the instrument is not in contact with the corrosive stream, the usual mechanical problems encountered with conventional type level controllers are eliminated. However, the Gagetron is an electronic device and subject to the difficulties commonly associated with this type of instrument. The proper maintenance and adjustment of the Gagetron requires an instrument man skilled in the application of electronics to instrumentation.

Another difficulty encountered with the installation of the Gagetron level control was building up the confidence of operators in the reliability of the instrument. It was necessary on Phillips' initial trials with the Gagetron to install try-cocks on the vessel so that the operators could "check up" on the instrument to their own satisfaction. In this manner operator resistance to the instrument is being overcome.

The first Gagetron in an alkylation unit was installed on the acid-oil leg of the acid re-run column at the Phillips Petroleum Co.'s Phillips, Texas refinery[1]. Both temperatures and pressures are high (300-400 F, 100-150 psig[2]) in this application. The measurement and control function is critical to process economy, since the controlled effluent from this column is discarded following neutralization and losses of acid could therefore be expensive. Heretofore, the principal application of the instrument had been in determining cracking catalyst levels[3].

When the wartime-built HF alkylation unit at what now is Phillips Petroleum Co.'s Sweeny, Texas, refinery was revamped extensively after several years' idleness, it was decided to employ modified Gagetrons for level control or indication in acid service. As a result the Sweeny installation now has the distinction of being the first to employ Gagetrons so extensively for both level indication and control. Because measurements are made through inch-thick vessel shells, it also is one of the largest users of radium in refinery processing, the present figure being 6025 mg. radium equivalent. This quantity is due to be increased shortly to approximately 75 mg.

Five Gagetrons Used

Now in operation at Sweeny are five Gagetrons; two more are being installed. Present services include liquid level measurement of deflorinator tower feed surge (11-ft. level range), deflorinator accumulator level recorder and low level alarm (7-ft. operating range), depropanizer accumulator level recorder controller

control feature not yet in use (4-ft. operating range), acid reflux column recorder-controller on acid oil-water discard to waste (24-in. range, level held constant to 0.5 in.), all scales in percent of range, and level indication for HF acid storage (12-ft. range, readings in feet and inches).

The two additional instruments will be used to control the interface level between hydrocarbon and acid phases in the defluorinator accumulator and the depropanizer accumulator, respectively, so that only the acid layer will be recycled to process.

In no case are there openings into the shell to accommodate the instrument. Radium sources are held against the shell with screwed collars, the collars being welded onto the shell. Each location is suitably marked with red warning labels. The detecting device (a modified Geiger counter with preamplifying system) also is located externally in pipe hangers and in most cases is separated from the vessel's shell by the external insulation. Generally, with the particular exception of the acid storage tank, try cocks are installed for use in event of instrument failure or removal for maintenance without disturbing processing.

Defluorinator Surge Tank

The defluorinator feed surge tank is a horizontal vessel of 11 ft. diameter, customarily operated nearly liquid full. It is desirable to know the liquid level in the vessel at all times. The liquid is the feed to the fractionation section of the unit and contains organic fluorides in addition to 0.4 vol-% free HF acid.

Because the Gagetron is located outside the vessel, each radiation particle must not only traverse the liquid but pass twice through the 0.875-in. thick shell either normal or at some other angle to the surface. Particularly because of this latter fact an unusual amount of radium is required, compared to the amount which would have been necessary had detector and gamma radiation sources both been located within the vessel.

The detector, consisting of the Geiger counter-tube and preamplifier assembly, is mounted in a length of 3-in. pipe located atop the shell, complying with N.E.M.A. Class I Group D specifications for hazardous locations. The Geiger counter tube at the end of the detector is positioned to make measurements at a point just far enough away from the head seam to clear the weld zone. Fig. 1 is a general schematic for liquid level installations.

There are seven sources, containing a total of 31.0 mg. radium as a radium salt ($RaCl_2$), located approximately equidistant from each other along the vertical diameter of the head. The bottom source is located on the shell, vertically underneath the counter tube. The source locations and radium contents are given in Table 1.

Table 1—Distribution of Radium Sources and Location On Defluorinator Feed Surge Tank Head

(Vessel 11 ft. I.D., 0.875 in. shell)

Source No. (Top to bottom)	Radium Equivalent, Mg.*	Vertical Distance Between Sources, in.
Counter	0.0	Top of vessel
1	3.0	12
2	4.0	24
3	4.0	24
4	6.0	24
5	5.0	24
6	5.0	24
7	4.0	Bottom of vessel
Total radium equiv. 31.0		Range 11 ft.

* Radiation strength at source is 1 millicurie per milligram of elemental radium content.

There are two reasons for the unequal source loadings shown in Table 1 and which apply to any Gagetron installation where more than one source is required. The first is that, by reason of location, the amount of metal to be traversed in penetrating the shell twice varies from angularity effects as well as minute differences in metal density which develop during fabrication of the steel plate. The second stems from the well-known law that the intensity of radiation received at any given point is inversely proportional to the square of the distance from the source.

Radiation intensity at the point of measurement from Source No. 1 is adjusted during installation by adding or subtracting radium in units (each unit is enclosed in an individual platinum capsule[1]), each containing multiples or sub-multiples of 1 mg.) until the radiation level total from the source is just reliably measureable when the vessel is liquid-full. This compensates for the thickness of liquid traversed as well as the total metal thickness involved. Similarly, all others are adjusted, the bottom source so that its "kick" is not excessive when the vessel is entirely empty, when integrated with the radiations from the other sources.

It will be noted from Table 1 that both vertical distances between sources and quantities of radium differ and, furthermore, that the quantity of radium is the same for several different pairs of adjacent sources, whereas vertical distances between sources is generally 24 in. These variations are accounted for because of the differing thicknesses of metal to be traversed by radiation particles from each source, as indicated schematically by the dashed lines of Fig. 1. It was intended by this arrangement to make each source, except Nos. 1 and 2, responsible for the measurement of a 24 in. incremental change in level of the vessel contents.

One of the particular advantages of the Gagetron is, once the quality of radium for any given source at a specific location has been determined, that it never again needs changing. Further adjustments are made on the detecting instrument only when new electrical components are installed during maintenance. The half-life of radium is 1580 years—a constant for all practical purposes.

This last also is the reason why "Cobalt 60", another well-known but less expensive radioisotope is not used. The half-life of this material is only 5.3 years. With its use in precision measurement, a periodic replacement of sources would be required and the instrument frequently recalibrated to compensate for the varying intensity of radiations as the source-material decayed.

The preamplifier magnifies the signal from the Geiger tube, the intensity of which is directly proportional to the intensity of radiation it receives, and transmits it to the control room by coaxial cable enclosed in a steel conduit. Behind the control panel itself, in weather-proof housings, are located the power source for the instrument and an amplifier. The latter again magnifies and integrates electronically the counter-tube signal sufficiently to actuate the indicator on the control panel.

The panel indicator has been, until recently, an indicating voltmeter calibrated linearly to read feet and inches. It now is being replaced with a modified Brown Instrument Co. recording pyrometer, the scale of which will be calibrated in percent-of-range. Provision will be incorporated to actuate a conventional low-level alarm which can be set by operating personnel to signal at the desired level.

Other Vessels

The principal differences between the installation on the acid storage tank and the defluorinator feed accumulator just described are that the liquid is 98% anhydrous hydrofluoric acid, the tank is 12 ft. in diameter with a shell thickness of 0.875 in., it uses 16.75 mg. radium, and a different arrangement of radium sources has been used to cut down the total requirement of radium. Each source determines level changes over a 24-in. range.

There are 12 radiation sources containing from 0.6 to 2.7 mg. radium each, the location and quantity of which are shown in Table 2. Proportionately less radium is required for this vessel, despite the greater range of level determination, principally because of the carefully determined arrangement of the sources. Source No. 4, for instance, must also penetrate 2.83 in. of steel, and No. 5, 2.6 in., while No. 12, on the bottom of the tank, only 1.75 in.

The purpose of this instrument is to determine fresh acid inventory

ority. Measurement of acid transferred to or from the process itself is accomplished with a conventional weigh tank which constituted a part of the original installation.

The installation on the deisopropanizer accumulator is very similar to that on the deflorinator feed surge tank, except that the operation is a conventional control processes to reset a controller actuating an air-operated motor valve on the effluent. This has not been used due to certain process flow arrangements not pertinent here. There is no alarm provision. The liquid is predominantly propane with 0.7 volume% free HF.

The vessel is 4 ft. in diameter with a shell thickness of 0.875 in. A total of 4.0 mg. of radium equivalent is installed in four sources at one end of the vessel.

The installation on the deflorinator accumulator, containing principally propane and isobutane with 0.7 vol.% HF, is basically identical to that of the deisopropanizer accumulator. The vessel, however, is 7 ft. in diameter and the shell 1.15 in. thick. Four radium sources are used with over three times more radium equivalent, the quantity being 13.8 mg. This vessel operates liquid full and a low level alarm is incorporated in the instrument.

Level Control

The two new instruments will be installed on the deflorinator and isopropanizer accumulators but entirely separate from the existing Gagetron installations on these vessels. Both accumulators have acid-gravity separators from which the bottom phase is returned to the acid settler tank whence acid is recycled to process. Each instrument will be used to indicate interface between the acid and hydrocarbon layers, thus periodically call the heavier acid phase to be withdrawn.

For these installations there will be two radium sources, respectively near the top and bottom of the level with provision for a third source in case position of the event it should be needed. Diametrically opposed and above the upper level limits on the line, as recommended by the two sources, will be located the detector-preamplifier unit of the instrument. It will record and control interface or loading a discharge valve in the effluent line from a receiver instrument located on the main control panel of the unit.

The installation in the acid leg of the acid regenerator or acid separator system as it may be better known, is quite similar to the processed installations for interface in the type the range of the instrument is 24 in. roughly symmetrical with the interface of the acid leg of the column, 2 ft. dia. by 11 ft. long. The column is insulated.

Table 2—Distribution of Radium Sources and Location on Acid Storage Tank Head

(Vessel 12 ft. I.D., 0.875 in. Shell)

Source No.* (Top to bottom)	Radium Equivalent, Mg.**	Vertical Distance Below Preceding Source, In.
1	0.50	0.00
2	0.50	6.00
3	0.50	7.75
4	0.50	9.00
5	0.50	10.00
6	0.50	10.00
7	0.50	10.00
8	0.50	10.00
9	0.50	10.00
10	0.50	10.00
11	2.00	10.00
12	2.00	10.00
13	2.00	10.00
14 (bottom)	2.40	17.00
Total radium equivalent	10.90	Total vessel 120.0

* Each source mounted for inter-relation of 0.5 in. radius.

** Radium strength at source as 1 millicurie per microgram of radioactive radium metal.

Two radium sources of 2.0 mg. each are used, located at the extremes of the range in direct contact with the metal shell. The Gagetron detector is located 1 ft. 6 in. above the lowest radium source and diametrically opposed, receiving radiation through the vessel insulation as well as the shell, which is of course traversed twice by the gamma rays. In operation, the level is held constant within 0.5 in., the instrument positioning a diaphragm valve on the lower bottoms effluent line conveying principally water and heavy oil to the sewers.

Since the charge to this column is one hydrofluoric acid contaminated with heavy hydrocarbons and some water it is vitally important that only the oily bottoms, containing but trace amounts of HF, be discharged to the neutralization clime-water pits. Otherwise losses of the expensive acid catalyst become excessive. At the same time, the oil level must not get too high, as this will interfere with lower efficiency in reclaiming acid for return to process.

Maintenance

Maintenance on the instruments and need for technical attention in their adjustment to process requirements has been satisfactory, considering the lack of experience with this type instrument. A few tubes have needed replacement in the electronic circuits, very possibly the result of rough handling during shipment and installation.

The principal problem on the single controller in operation has been its extreme sensitivity, both to changes in adjustment and level changes, resulting in excessive cycling. In changing the set-point, operators inadvertently struck the sensitivity adjustment with their fingers until the knob was moved to another location within the instrument, an incidental design change which the manufacturer has adopted also. Juggling throttling response and reset controls has practically eliminated "hunting".

Another problem came about from "ghost" responses on one of the two accumulators. This proved mysterious for a time. The two vessels are side-by-side. It was finally proved that the two Gagetrons, which also were side-by-side, were interfering with one another, the radium sources from the one vessel affecting the counter tube on the other. A lead shield between the two vessels proved ineffective; however, additional lead shielding of special design is being installed. If this does not suffice, one of the Gagetron assemblies will probably be moved to the opposite end of the vessel.

A particular point of interest is that, while operating personnel may pass quite close to the radium sources dozens of times daily, they are in no danger of being "burned." That is, there is no danger unless they violate safety rules which state that any distance beyond 4 in. from the source is safe for a normal 8-hour shift.

For maintenance personnel the story is somewhat different, since their duties might conceivably require them to remain near a Gagetron for a considerable time, such as installing and working on a valve, or removing a source to permit work on a vessel. Fortunately radium will not induce radioactivity in other substances, so that there need be no worry about "hot atoms" once the source is removed or adequately shielded.

Naturally it is up to supervisors to determine whether or not the work at hand may make desirable the removal or shielding of sources for safety reasons. If so, the sources are removed in accordance with recommendations of the manufacturer, based on findings of the Atomic Energy Commission and others, covering the safe handling and storing of radioactive materials.

It is not anticipated that any personnel will receive a "dose" of radiation sufficient to require treatment or render further exposure inadvisable except through an unusual accident or willful exposure.

Gagetrons for the Sweeny installations were furnished by Instruments, Inc., Tulsa, through its Houston representative, O. W. Fitz (Gamma Instrument Co.).

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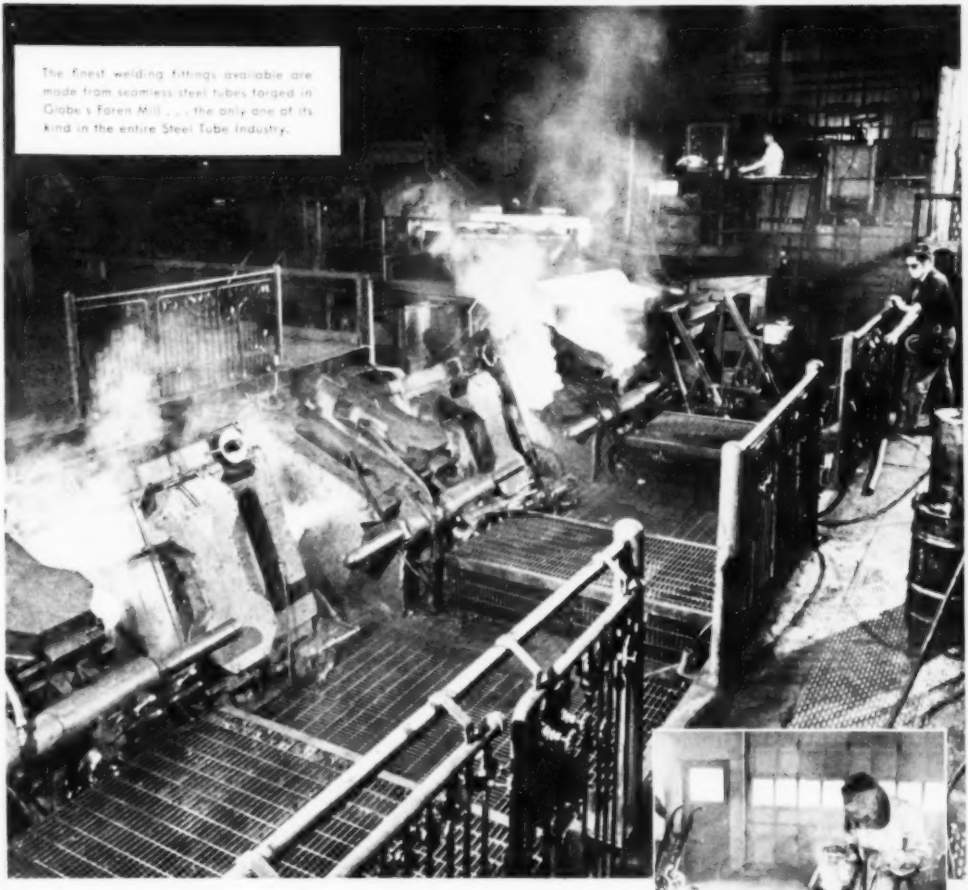
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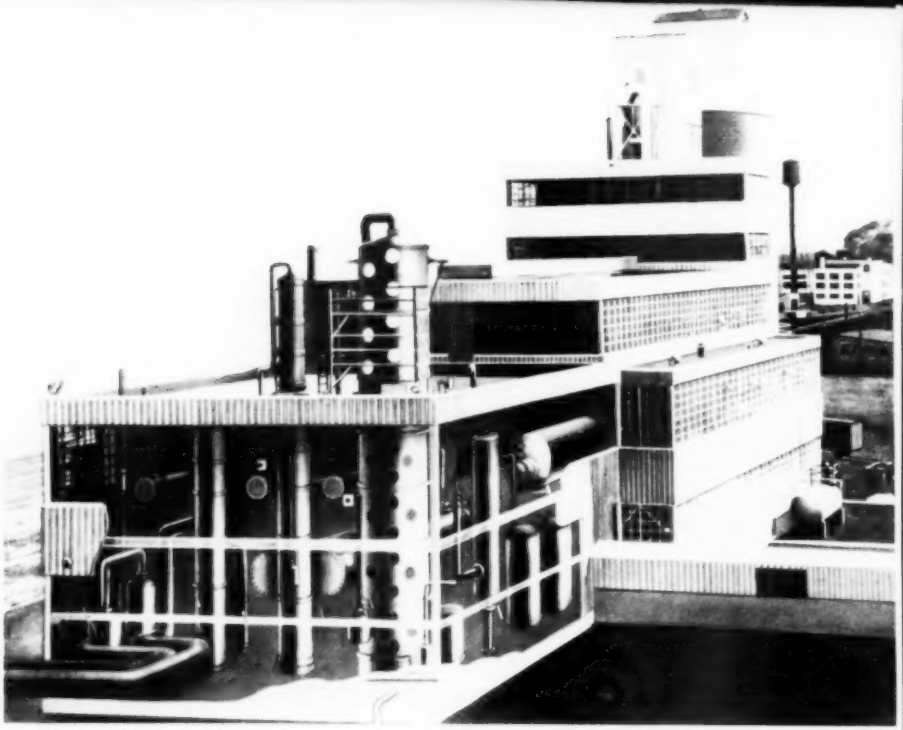

New furfural plant at Omaha showing in the foreground a cutaway view of the chemical process section.

This new furfural plant at Omaha is the latest addition to the production facilities of the Quaker Oats Chemicals Department. The third and largest of its kind, it incorporates the most modern features of engineering design backed by operating experience from the first two plants. Specification furfural was produced within forty-eight hours of starting up the distillation and recovery equipment which was designed and built by Vulcan.

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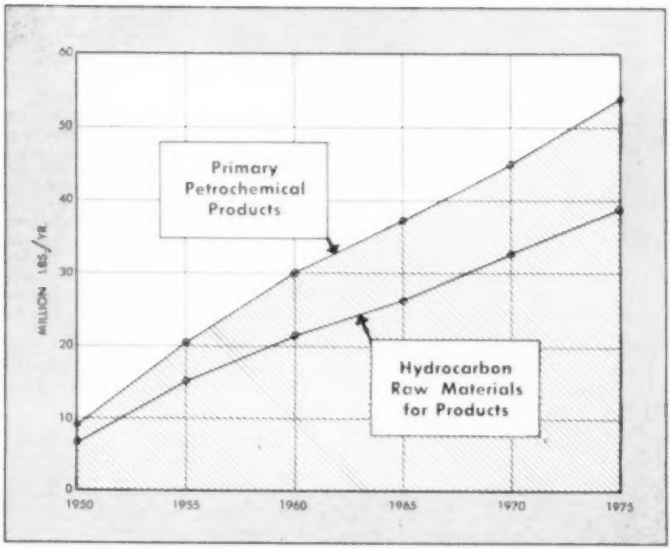


Forecasts for Petroleum Chemicals

President's Materials Policy Commission Predicts more than 5-fold growth by '75

A CONTINUING rosy future for the already booming petrochemical industry has been forecast by the President's Materials Policy Commission.

In its recent report "Resources for Freedom" the Commission presents predictions that:

1—Output of primary petrochemical products will increase to nearly 55 billion pounds annually by 1975, as compared to a 1950 output of 9.9 billion lbs.

2—Hydrocarbon raw materials for this output will be nearly 39 billion lbs. annually in 1975, not including any hydrocarbons used for fuel purposes.

3—During the 25-yr. period ending in 1975, a total of $5,201,500,000 will have to be invested in new plants to meet the increased demand for primary petrochemical products.

These predictions are based on the assumption that any increases over present requirements for the raw materials needed to make the end products in question would come from petroleum and natural gas. The hydrocarbon requirements, therefore, represent the extreme quantities that would be needed should no additional material come from other sources, such as coking or coal hydrogenation.

On the other hand, the product output figures are restricted to primary petrochemical products, which have been defined as those chemicals derived directly from (a) hydrocarbon intermediates (reactive petroleum derivatives, such as acetylene, ethylene, propylene, butylenes, etc.), (b) natural gas, or (c) selected petroleum fractions.

Commission Established Last Year

The President's Materials Policy Commission was appointed by President Truman early in 1951 "to study the broader and longer range aspects of the nation's materials problems as distinct from the immediate defense needs" and "to make an objective inquiry into all major aspects of the problem of assuring an adequate supply of production materials for our long-range needs. . ."

The report of the Commission, "Resources for Freedom," was presented to the President this past June and recently made public.*

In its study of petrochemicals, the Commission enlisted the help of private industry. Dr. Gustav Egloff of Universal Oil Products Co. prepared a report on "Oil and Gas as Industrial Raw Materials" and Standard Oil Development Co.

*Copies of the President's Materials Policy Commission report are available from the Supt. of Documents, Government Printing Office, Washington 25, D. C. The complete report (five volumes) is $6.25. Individual volumes are priced as follows: Vol. I, Foundations for Growth and Security, $1.25; Vol. II, The Outlook for Key Commodities, $1.50; Vol. III, The Outlook for Energy Sources, $0.50; Vol. IV, The Promise of Technology, $1.75; Vol. V, Selected Reports to the Commission, $1.25.

one on "Forecasts for Petroleum Chemicals."

The latter report (chapter II in volume 4 of "Resources for Freedom") is presented below with some of the data on fuel and utility requirements omitted.

AT THE request of the President's Materials Policy Commission, Standard Oil Development Co., in cooperation with the Chemical Products Department of Esso Standard Oil Co., has made a long-range, nation-wide survey of the petroleum chemical industry. In accordance with the request of the Commission, this survey has attempted to establish the trends and requirements of the entire petrochemical industry at 5-year intervals from 1955 to 1975. Specifically, these requirements embrace (a) petroleum and natural gas raw materials, (b) investments for new petrochemical plants, (c) utilities and fuel, and (d) steel and other metals for new plant construction.

Summary

As a basis for the long-range forecasts of petrochemicals requirements, it has been assumed that the industry will develop under an "armed peacetime" economy, but without an open war. And it is also assumed that the industry's growth will be commensurate with an expanding population and an increasing standard of living. No allowance has been made for any serious economic recession. Furthermore, it is assumed that petroleum will continue to increase in importance as a source of energy requirements. Also, no allowance has been made for any byproduct chemicals from synthetic liquid fuels manufacture. In the event of a crude oil shortage it is believed that, from a strictly economic standpoint, the use of shale oil would precede fully synthetic fuel. The results of this survey are applicable if shale is used to augment crude oil supplies, excepting that byproduct ammonia from shale processing would reduce the amount required from natural gas.

In reporting the results of this survey, it has seemed inadvisable to present figures on individual petroleum chemicals. Forecasts on the requirements for a particular chemical 25 years hence are unavoidably controversial. While the estimate of one may be low, for another it may be high. By grouping these together the reliability of the study is greatly strengthened. Furthermore, this reduces the danger of erroneous interpretations being drawn. Eight such groupings, covering end-uses of petrochemicals, have been chosen. Forecasts on two of the groups, namely, plastics and synthetic fibers, were furnished by the Commission.

The end-use groups are listed below together with some of the major products included therein.

Synthetic fibers. Nylon, Dacron, acrylic, other synthetics, and cellulosics (acetate rayon).

Synthetic rubbers. Buna-S (types), butyl, neoprene, and nitrile (Buna-N).

Plastics, resins, and plasticizers. Polyethylene, alkyds, vinyls, polystyrene, phenolics (urea and melamine), cellulosics, and other.

Protective coatings (including solvents). Aromatics, alcohols, ketones, glycerine, and other.

Automotive chemicals. Tetraethyl lead fluid and other additives, antifreezes, and hydraulic fluids.

Nitrogen products (including fertilizers), detergents, and miscellaneous items. Insecticides, herbicides, dyes, and miscellaneous solvents.

The important observation which may be made from the survey is that petrochemicals, even in 1975, probably will be a relatively minor consumer of petroleum and natural gas. It will be noted from Table 1 that the petroleum hydrocarbon raw material consumed in producing petrochemicals in 1975 is equivalent to only 2% by weight of the probable domestic petroleum and natural gas requirements. It is only 2.7% by weight when including liquid hydrocarbons degraded to fuel gas. When including all fuel for the operation of the petrochemicals plants, the total hydrocarbon requirements are only 5.5% of the petroleum and natural gas requirements. The comparable 1950 figures are estimated to be about 0.7% and 1.9% by weight. The 1975 requirements allow for a phenomenal growth of the plastics industry based on the forecasts of demand supplied by the Commission.

Table 2 summarizes the hydrocarbon raw materials requirements and the primary product output for the eight end-use groups. Plastics is outstanding among the groups as the large volume consumer of petrochemicals. Benzene and ethylene, required for phenol, styrene, and polyethylene, account for nearly 80% of the hydrocarbon raw materials needed for plastics in 1975. By that year, nearly 50% of the hydrocarbons used in making chemicals from petroleum will be required by the plastics industry alone. Thus it follows that the reliability of this survey depends in a large measure on the accuracy of the plastics forecast.

The investments shown in Table 3 provide for new plants required after 1950 to meet the requirements scheduled for succeeding 5-year periods. It is considered that such plants would be added in economic-sized units. Investments have been based on June 1950 construction costs. Money is included for offsites and steam and power generation. The investment coverage in this survey is 85%, based on tonnages of hydrocarbon intermediates and primary petrochemical products. Information was not available to permit 100% coverage.

From a long-range standpoint, the supply picture for olefins and aromatics is encouraging. Butylenes are perhaps in tightest supply. Here petrochemicals must compete with aviation gasoline which requires butylene alkylate. However, in the long run, the increasing use of jet fuel is expected to ease the situation. A comfortable surplus of butylenes is indicated by 1975. The natural gas requirements excluding fuel needs, for such chemicals as ammonia, methanol, ethylene, acetylene, etc., amounts to only 2.3% of the probable 1975 consumption.

Basic Assumptions

Before proceeding to a more detailed discussion of the predicted long range picture of the petrochemical industry, it is important that a clear understanding be obtained of the general basis. Certain assumptions have been made which limit the scope of this survey, but which allow the results to be presented in a reasonably clear cut fashion. Needless to say, several alternative bases might have been chosen, each of which would have resulted in a somewhat different picture. However, it is believed that the conclusions drawn would not have differed from those presented herein.

No major war. It is assumed that the petrochemical industry will develop under the conditions of armed peacetime economy which prevail today. It is further assumed that this country's major rearmament effort will be completed by 1955.

Synthetic fuel not a major factor. It is assumed that there will be no major construction of a synthetic fuels industry. Consequently, no allowance has been made for any significant quantity of byproduct petrochemicals being derived from synthetic fuels manufacture. In the event of a crude oil shortage it is believed that the next most likely step in meeting the Nation's increasing energy needs would be the use of shale oil. The major known effect of such a step on the petroleum chemical industry would result from the byproduct ammonia obtained in processing shale. This would reduce the requirements of natural gas for ammonia.

Type of raw materials from refining operations unchanged. Petroleum products have been considered as derived from existing refining processes. Increased and more severe catalytic cracking plus catalytic reforming of heavy virgin naphtha will provide for the higher octane gasoline requirements of future automotive vehicles. Thus, increased supplies of hydrocar-

Table 1—Estimated Petroleum and Natural Gas Requirements for the U. S. Petrochemical Industry—1950 to 1975

Year	Primary product output, million lbs./yr.	Hydrocarbon going into product[1]		Hydrocarbon going into product and liquid degraded to fuel gas[2]		Hydrocarbon raw material and fuel requirements[3]	
		million lbs./yr.	% of total petroleum and natural gas requirements[4]	million lbs./yr.	% of total petroleum and natural gas requirements[4]	million lbs./yr.	% of total petroleum and natural gas requirements[4]
1950	9 000	6 300	0.6%	7 400	0.7%	10 100	1.0
1955	20 240	15 000	1.1	16 920	1.3	21 540	1.6
1960	29 240	21 310	1.4	25 300	1.6	32 870	2.1
1965	37 470	27 000	1.6	32 200	2.1	74 500	4.4
1970	43 610	32 800	1.8	44 500	2.4	90 000	4.9
1975	54 180	48 180	2.0	65 200	2.7	106 740	5.5

(1) Cumulative requirements for both new and existing capacity; represents hydrocarbon going into products, byproducts and losses.
(2) Includes volatile and heavier hydrocarbons which are degraded to fuel use.
(3) Includes direct fuel gas fuel for utilities.
(4) Percent figures computed on basis of weight. Requirements based on unofficial estimates of domestic requirements for petroleum and natural gas, including imported petroleum and petroleum products.

Table 2—Hydrocarbon Raw Material Requirements and Primary Product Output of Petrochemicals by End-Use Groups—1955 to 1975

(Millions of pounds annually)

	1955		1960		1965		1970		1975	
	H.C.	P.P.	H.C.	P.P.	H.C.	P.P.	H.C.	P.P.	H.C.	P.P.
1—Synthetic fibers	1,040	1,550	1,510	1,820	2,010	2,100	2,200	2,420	2,340	2,740
2—Synthetic rubbers	1,040	2,200	2,250	2,800	2,850	3,960	2,590	3,190	3,130	3,510
3—Plastics and plasticizers	5,450	4,350	9,510	8,470	16,440	13,800	19,920	19,320	17,540	24,670
4—Protective coatings	1,350	1,180	1,510	1,500	1,830	1,870	2,180	2,230	2,530	2,560
5—Automotive chemicals	1,200	2,180	1,460	2,550	1,670	2,800	1,920	3,150	1,930	3,400
6—Nitrogen products	1,430	2,720	2,220	4,230	2,930	5,570	3,420	6,500	3,940	7,670
7—Detergents	500	600	700	830	860	940	970	1,060	1,020	1,130
8—Miscellaneous	3,630	5,120	4,350	6,220	4,800	6,800	5,420	7,580	6,050	8,500
Hydrocarbons to products and losses	15,840		21,510		27,000		32,880		36,760	
Liquid hydrocarbons degraded to fuel	1,060		3,790		5,200		11,620		14,430	
TOTAL hydrocarbons consumed	16,900		25,300		32,200		44,500		51,190	
Primary Product Output		20,240		29,240		37,470		43,610		54,180

H.C.—Hydrocarbon raw materials
P.P.—Primary petrochemical products

Table 3—Investment Requirements for Petrochemicals by End-Use Groups—1955 to 1975

(Figures in millions of dollars for new capacity coming on line in the years indicated)

End Use Group	1955	1960	1965	1970	1975	Total
1—Synthetic fibers	93.6	91.6	24.2	16.6	20.7	246.7
2—Synthetic rubbers	126.4	130.9	114.2	54.8	113.6	634.3
3—Plastics	322.2	497.9	649.0	506.1	504.3	2,488.5
4—Surface coatings	46.2	58.3	66.1	37.1	94.3	299.5
5—Automotive chemicals	108.0	102.0	93.0	77.0	95.2	484.6
6—Nitrogen products	124	121.8	123.5	122.4	123.4	615.6
7—Detergents	14.7	8.8	8.0	4.8	6.8	43.1
8—Miscellaneous	149.5	104.4	116.1	115.8	100.7	585.1
TOTAL	842.7	1,116.0	1,081.7	1,054.5	1,054.5	5,201.5

(1) Investments are for June 1956 construction costs, and include inside offsite and utilities requirements. The investment increase is about 8% for primary products and ethylene. No investments are included for any end products excepting synthetic rubber.

bon raw materials such as propylene and butylenes will become available as gasoline requirements increase.

Present-type petroleum products. No allowance has been made for the development of radically new types of automotive fuel which might render existing processes obsolete, e.g. the use of jet fuel or liquefied petroleum gases. Furthermore, it is assumed that the use of synthetic lubricants will not be a major factor.

Present energy sources. It is assumed that the use of atomic, solar and tidal energy will not be a major factor affecting the consumption of petroleum and natural gas.

No severe economic depression. It is assumed that the requirements for petroleum and the end-use products derived from petrochemicals will enjoy a normal growth as determined by an expanding population and the increasing standard of living of the people. A population of 193 million persons in the United States is anticipated by 1975. No allowance has been made for any interruption of the Nation's economic growth by a major financial crisis.

Unforeseen technological developments would not alter conclusions. About 10 years on the average is required to translate an embryonic idea from the test tube to commercial importance. Obviously, one cannot predict what new petrochemicals, petrochemical processes or new end-uses may evolve by 1975. However, it is assumed that such technological developments would not affect the requirements of petroleum for petrochemicals nor the predicted investments within the accuracy of these figures.

Raw Materials

Requirements of natural gas and petroleum for chemicals are detailed in Table 4. The supply picture in 1975 for these major hydrocarbon raw materials and hydrocarbon intermediates would appear to be as follows:

Natural gas. Some 14.3 billion lbs. annually of methane, ethane, and higher paraffins will be needed for the manufacture of ammonia, methanol, ethylene, acetylene, etc., in 1975. This represents only 2.3% of the probable domestic consumption of natural gas by then.

Ethylene. Ethylene is a byproduct of refinery cracking operations, notably catalytic cracking. Some ethylene is produced by destructive liquid cracking processes. However, the greater part of the 8 billion lbs. a year of ethylene required in 1975 probably will be supplied by thermally cracking ethane. A large part of the ethane required can be obtained from refinery fuel gases, while additional supplies, as will be noted from Table 4, must be recovered from natural gas. Conservatively allowing 5%

Table 4—Classified Petroleum and Natural Gas Requirements for Petrochemicals—1955 to 1975

Billions of pounds annually

	1955	1960	1965	1970	1975
Natural gas:					
[illegible]	4,500	6,810	8,100	9,850	11,100
[illegible]	1,510	2,850	3,500	3,500	3,720
[illegible]	6,340	8,210	10,000	12,500	14,270
Petroleum:					
Ethylene					
[illegible]	1,310	2,340	3,250	4,925	4,915
[illegible]	480	820	1,050	1,500	1,920
[illegible]	2,360	3,660	5,000	6,310	5,960
Propylene	1,940	3,160	4,200	5,500	7,420
Butylenes and butanes:					
[illegible]	1,440	2,140	2,450	2,850	3,040
[illegible]	700	820	1,420	1,940	2,880
[illegible]	2,270	2,960	3,870	5,070	7,420
Benzene, toluene and higher	540	800	740	900	1,960
Isobutane:					
[illegible]	1,700	3,450	7,700	10,120	12,650
[illegible]	1,000	1,300	2,250	10,560	13,050
[illegible]	6,150	10,600	16,000	20,800	25,700
Summary					
[illegible]	6,340	8,210	10,000	12,500	14,270
[illegible]	9,700	12,900	18,300	25,300	31,310
[illegible]	15,940	21,110	27,900	37,800	45,580
[illegible]	1,440	8,540	9,200	11,540	14,470
[illegible]	18,520	27,800	36,200	44,700	53,220

(1) Excludes requirements for both existing and new petrochemicals production.
(2) Includes some higher paraffins from methane and ethane.
(3) Including gas, thermofor cracking of liquid petroleum fractions.

of ethane in natural gas, it is estimated that less than 10% of the potential ethane would be required, based on the probable 1975 domestic natural gas consumption.

Propylene. This is obtained entirely as a byproduct from refinery cracking operations, mainly catalytic cracking. It is roughly estimated that 7.8 billion lbs. a year will be required in 1975. This compares with a predicted production of around 25 billion lbs. a year. The competing fuel products uses of propylene are catalytic polymer for motor gasoline and alkylate for aviation gasoline. As the requirements of propylene for chemicals consume only 11% of the potential production, the supply outlook is considered to be very favorable.

Butylenes. Like propylene, butylenes are a byproduct of refinery cracking processes. In contrast to predicted 1975 requirements for butylenes of about 3.4 billion lbs. (16 million bbls.) including about 0.4 billion lbs. degraded to fuel gas, the probable production is about 28 billion pounds (132 million bbls.). Alkylate requirements for aviation gasoline, after making allowances for the use of jet fuel in the larger part of the military and commercial aircraft by 1975, are estimated to require from 20 to 25% of the butylenes produced. Butylenes requirements for alkylate can be reduced by alkylating propylene and pentenes. And butylenes requirements for synthetic rubber can be reduced by manufacture of butadiene from n-butal butane. With this flexibility, the butylenes supply situation in 1975 is believed to be quite satisfactory. The situation will be somewhat tighter over the next few years because of the growing military needs for aviation gasoline. However, for 1955-60, the butylenes required for aviation alkylate would appear to require only 30 to 40% of the probable production.

Aromatics. There appears to be more than ample raw materials to produce the tremendous demand for aromatics predicted by 1975. The major share of this is benzene, most of which will be required for plastics. Toluene, xylenes, and naphthalene likewise will increase in demand several-fold within the next quarter century. Surface coatings will be the principal consumer of these aromatic chemicals.

The lower aromatics may be synthesized in several different ways and from various petroleum components. It is outside the scope of this study to forecast the utilization of aromatics raw materials from the standpoint of economics. However, the most important method today is dehydrogenation of naphthenes by catalytic reforming of selected virgin naphtha fractions. Isomerization to convert methylcyclopentane to cyclohexane may be integrated with low-pressure catalytic reforming to maximize benzene. Similarly, in producing toluene, the dimethylcyclopentane must be isomerized first to methylcyclohexane.

Isomerization and dehydrogenation can be made to proceed simultaneously. This is done by the "hydroforming process" under relatively high pressures and in the presence of recycled hydrogen. Supported molybdenum, tungsten, chromium, or platinum catalysts are employed. Two process improvements in hydroforming are (a) "platforming," which uses a platinum catalyst at high pressure, and (b) "fluid" hydroforming, which uses powdered catalysts containing molybdenum or other metals at lower pressure. Both "platforming" and two-step isomerization-hydroforming are used commercially today.

Based on potential raw material, catalytic cyclization of normal hexane to benzene and normal heptane to toluene may be important processes in the future. Another possible synthesis is dealkylation of alkylated aromatics. Some aromatics are available as byproducts from severe high-temperature cracking of oils for the production of unsaturates. Catalytic naphtha contains only small amounts of benzene and toluene and has not been of much interest. Also, crude oils contain benzene and toluene in small amounts. Benzene contents range from 0.001 to 0.1%. Special recovery of these lower aromatics from crudes are likely to be of economic interest only when combined with aromatics synthesis operations.

All of the above synthesis require a further processing step to purify the aromatics for use as chemicals. The contaminants may be saturated hydrocarbons or they may be olefins and diolefins. Extractive distillation, solvent extraction, and silica gel adsorption are the present commercially available techniques.

Returning to the question of aromatics supply, it would appear that the potential benzene supply, through the various routes described, could be four- or five-fold the predicted 1975 demand. In the case of toluene and xylenes, aviation gasoline will require a share. However, after satisfying probable aviation requirements it is estimated that chemicals will require less than 10% of the remainder. This is an important consideration from the standpoint of meeting future motor gasoline quality.

Forecasts

The estimated hydrocarbon raw-material requirements for petrochemicals have been based on forecasts of petrochemicals, together with end-use patterns, which were prepared by the Chemical Products Department of the Esso Standard Oil Co. These are forecasts included in Table 2. Estimated future requirements of synthetic fibers and plastics were supplied by N. M. Elias of the President's Materials Policy Commission and are understood to represent a consensus of industry. These two end-use groups have determined the forecasts of many of the major petrochemicals. Notably, ethylene and benzene requirement are markedly sensitive to changes in the plastics picture. Approximately one-half of the hydrocarbon raw materials requirements in 1975 are for resins and plastics.

Referring to Table 2, it should be appreciated that the quantity of pri-

Table 6—Summary of Metals Requirements, U. S. Petrochemical Industry—1955 to 1975 (1)

(Figures are in tons)

End use group	1 Synthetic fibers	2 Synthetic rubbers	3 Plastics	4 Protective coatings	5 Automotive chemicals	6 Nitrogen products	7 Detergents	8 Miscellaneous	Total
5 years ending 1960									
Steel	20,000	146,000	280,000	41,000	112,000	10,000	12,000	124,000	784,000
Cast iron	2,200	4,800	8,400	1,200	2,500	320	800	2,500	24,600
Ferroalloys	4,000	8,500	13,500	2,200	6,500	660	700	7,150	43,200
Nonferrous metals	920	1,760	3,240	480	1,350	120	150	1,500	9,440
5 years ending 1965									
Steel	45,000	173,000	415,000	52,000	84,000	110,000	8,000	126,000	931,000
Cast iron	1,200	2,500	13,000	1,000	2,600	2,400	200	5,000	28,950
Ferroalloys	2,000	6,500	24,000	1,900	4,000	6,500	460	7,500	53,860
Nonferrous metals	510	1,260	5,000	390	1,000	1,500	90	1,500	11,150
5 years ending 1970									
Steel	29,000	93,000	431,000	50,000	68,000	101,000	7,000	97,000	876,000
Cast iron	900	1,000	13,000	940	2,500	3,200	210	4,000	25,850
Ferroalloys	1,700	3,540	25,000	1,700	3,900	5,800	380	5,000	49,580
Nonferrous metals	310	1,140	5,200	360	820	1,200	80	1,200	10,350
5 years ending 1975									
Steel	31,000	78,000	461,000	51,000	65,000	102,000	4,000	86,000	878,000
Cast iron	1,200	2,500	14,500	960	2,000	3,200	130	3,000	27,490
Ferroalloys	2,200	4,500	27,000	1,800	3,700	5,900	230	5,400	50,730
Nonferrous metals	470	940	5,800	370	780	1,200	50	1,200	10,610
5 years ending 1975									
Steel	23,000	55,000	477,000	52,000	58,000	103,000	6,000	66,000	840,000
Cast iron	700	1,000	15,000	1,000	1,900	3,200	190	2,700	25,580
Ferroalloys	1,300	3,100	27,500	1,800	3,500	5,900	330	4,000	56,430
Nonferrous metals	270	1,110	5,700	350	800	1,200	70	1,000	10,490
Total (1955-75)									
Steel	204,000	525,000	2,155,000	160,000	387,000	426,000	37,000	529,000	4,332,000
Cast iron	6,200	16,000	64,400	5,200	12,000	13,320	1,330	16,500	134,470
Ferroalloys	11,700	26,500	119,000	9,400	22,300	24,500	2,100	30,400	230,000
Nonferrous metals	2,430	6,340	24,740	1,950	4,840	5,020	440	6,440	52,840

(1) Covers about 85% of the petrochemical production

mary products shown for a particular end-use group is not the quantity of end-use products. Also, it should be understood that these primary products represent only those derived from petroleum and natural gas.

It will be noted that for most end-use groups the weight of the primary products is greater than the weight of the hydrocarbon raw material. The general explanation of this, which applies to all groups excepting synthetic rubber, lies in the fact that many of the primary products are formed by the addition of nonhydrocarbon material to the hydrocarbon. As examples, the various alcohols, ethylene oxide, ethylene glycol and glycerine, all include oxygen; other products include chlorine or bromine. Ammonia is largely nitrogen, with the hydrogen only being derived from hydrocarbons. In the case of synthetic rubber, inclusion of nonhydrocarbon material in the primary product is a minor factor. Here the primary products include an unavoidable duplication arising through consideration of both benzene derived from petroleum and all of the styrene as primary products. Styrene is considered as a primary product of ethylene. However, the benzene going into styrene includes a proportionate share of coal tar benzene.

The only other duplication in primary products occurs in the case of cumene, which is made by alkylating benzene with propylene. Both cumene and benzene are primary products. However, there are no duplications in hydrocarbon raw materials.

In addition to the general assumptions which were made to establish the over-all pattern of this survey, certain other conditions have been defined to limit the scope of the forecasts and to set the course of future trends.

a) The forecasts have been restricted to nonfuel uses of petroleum raw materials. Thus, aromatics for use in aviation gasoline have been excluded.

b) Abnormal requirements of chemicals (e.g., toluene and ammonia) for explosives have been excluded.

c) Petroleum byproducts such as sulfur and helium have not been included.

d) Excluded also are requirements of heavy oils and natural gas for the manufacture of carbon black.

e) Gradual eclipse or fermentation ethanol by synthetics has been assumed.

f) Virtually all increases in aromatics are assumed to come from petroleum.

g) It has been assumed that natural gas will gradually supplant coke as a source of synthesis gas for methanol and ammonia.

h) Additional rubber requirements will be mainly synthetic and probably the new capacity will be largely for improved types over Buna-S.

i) Due consideration has been given to the critical shortages of sulfur and chlorine. Thus, it has been assumed that manufacture of phenol by the cumene hydroperoxide synthesis will become increasingly important as compared to the benzene chlorination and sulfonation methods.

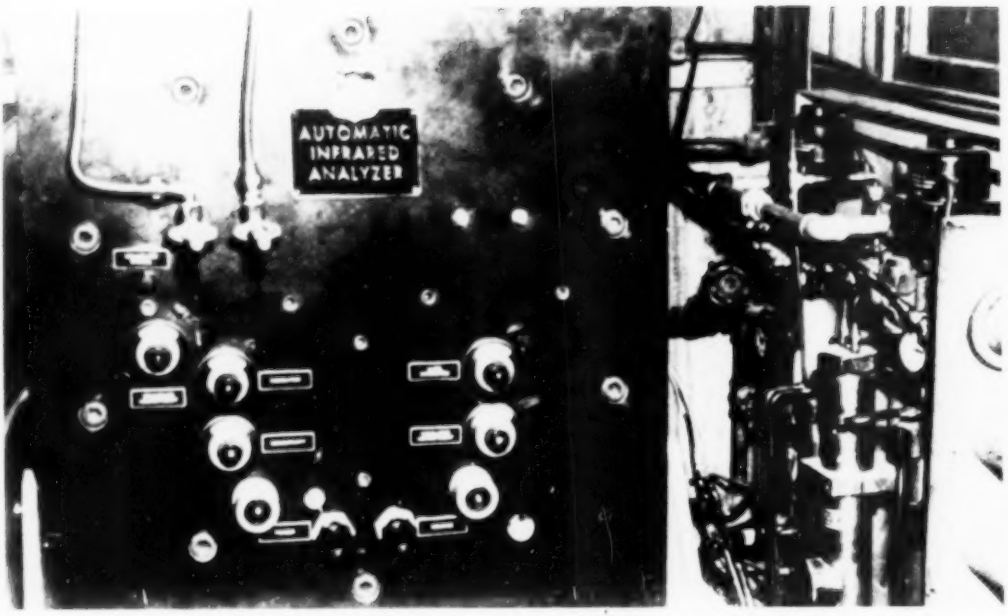
j) It is visualized that the detergents industry will continue to enjoy a vigorous growth. This will limit the availability of byproduct glycerine from soap manufacture and require increasing production of synthetic glycerine from petroleum.

k) Acetylene is expected to become an important petrochemical raw material. Petroleum acetylene by partial oxidation of methane or regenerative cracking of propane now offers a potentially cheaper source of supply than calcium carbide. It is assumed that future increases in acetylene requirements for chemical synthesis will be largely from petroleum sources.

Table 5 presents a very rough estimate of the metals required for the construction of petrochemical plants covering about 80% of the petrochemical operations. This is based on experience within this company and includes representative types of plants. The metals are grouped into four broad classes as follows: steel, cast iron, ferrous alloys (including stainless steels and the like), and nonferrous metals (e.g., copper, lead, bronzes, etc).

The requirements shown provide for onsite, offsite, and utilities sections of the plants. Also they include machinery (pumps, compressors, motors, etc) as well as towers, reactors, piping, structural steel, and such.

Although the nonferrous metals represent a very broad group, it has not been feasible to make a more detailed breakdown.



PLANT INSTALLATION of the infrared analyzer for carbon dioxide analysis

Automatic Gas Analyzer Pays Off

How Phillips used infrared for rapid analytical control of butylene dehydrogenation catalyst regeneration

By K. V. KRATOCHVIL and D. E. BERGER
Chemical Engineering Div., Phillips Petroleum Co., Bartlesville, Okla.

IN THE production of butadiene by dehydrogenation of normal butylenes over catalyst as practiced at Plants Plant, Butadiene Section, it has been demonstrated that it is of considerable importance, both from economic and production standpoints, to maintain the catalyst at a high degree of activity. Probably the most important factor in this regard is the carbon regeneration. In operation it has been found that regeneration must be completed from cycle to cycle and as thoroughly as the considerations of burning time and oxygen control will permit.

During most of the regeneration cycle the temperature may be used as a guide for correct burning conditions; however, near the end of the cycle a more definitive method is needed and this need has been met by use of an infrared analyzer to monitor the carbon dioxide content of the effluent regeneration gas. The relationship of carbon dioxide content of the effluent regeneration gas (water saturated at atmospheric conditions) to the completeness of regeneration had been established previously by Orsat type carbon dioxide determinations made at frequent intervals during the regeneration.

The CO_2 concentration was known to rise to a maximum of about 20 mol % shortly after start of regeneration and to decrease to a few tenths of a per cent near the end of regeneration. The inherent inaccuracy of both manual and automatic Orsat analysis as well as continuous specific gravity determination made these methods unsuitable for accurate detection of very low concentrations of CO_2. Also, the excessive manpower requirements for manual Orsat analysis makes it undesirable.

In view of these considerations, infrared absorption spectroscopy was studied as an analytical method for CO_2 detection in the possible presence of nitrogen, oxygen, carbon monoxide, and water vapor. These studies finally resulted in adaptation of a Phillips Automatic Infrared Analyzer for this analysis. The effluent gas CO_2 content during the regeneration period is recorded on a strip chart type Brown Electronik potentiometer located in the unit's control house.

The recorder chart is a linear 100-division strip but, as can be seen later, the relationship of CO_2 content to chart reading is far from linear; more nearly logarithmic, which lends considerably to the readability in the desired regions (that is, low concentration near the end of the regeneration period).

The over-all operation of the unit has definitely been considerably improved as regards conversion level without loss of selectivity, since the infrared analyzer has provided the operators with a continuous highly accurate CO_2 analysis by which the regeneration operations may be guided

to bring about reproducible operations.

Design of Analyzer

The Phillips Automatic Infrared Analyzer is a double beam differential photometer type. A schematic drawing of the optical system is shown in Fig. 1. Calcium fluoride windows were used in the sample cell in order to obtain transmission beyond the absorption region of the filters. A thin quartz window in one beam and a thin sapphire window in the other beam serve as a filter system. These filters are inserted between the sample cell and the bolometer as indicated in Fig. 1. A sketch which indicates the method of detection used in such a filter system is shown in Fig. 2.

Detection of the changes in infrared energy received by the bolometer is accomplished by connecting the bolometer resistive elements into a modified Wheatstone bridge arrangement as shown in the schematic wiring diagram of Fig. 3. The bridge unbalance is restored by a high gain a-c type servo-amplifier system. The servo-motor driven shaft of the slidewire used for rebalancing the bridge is rigidly connected to a second slidewire which is used for telemetering information to a standard recording potentiometer.

Telemetering is accomplished by applying a regulated d-c potential to the telemetering slidewire. The telemetered signal can be transmitted several thousand feet. The instrument automatically standardizes itself by means of a signal timing circuit initiated by the plant clock which controls the process and regeneration cycles. The standardization, which takes approximately five minutes, is arranged to occur at the beginning of the process cycle. Plant air is used as standardizing gas. This procedure was chosen because the CO_2 content during the regeneration cycle can never be lower than the CO_2 content of the plant air used for the regeneration process.

The optical system and all of the electrical system thus described are enclosed in an explosion-resistant housing which can operate in Class I, Group D locations as specified by the National Electrical Code as approved by the American Standards Association and National Board of Fire Underwriters. Electrical wiring is brought out through conduit. On the first page is a photograph of the plant installation, showing the controls on the front panel for setting the operation conditions of the instrument.

Design of Sampling System

Experience with past instrumentation problems has shown that the success of this type of plant instrument is quite dependent upon proper sampling system design. Considerable

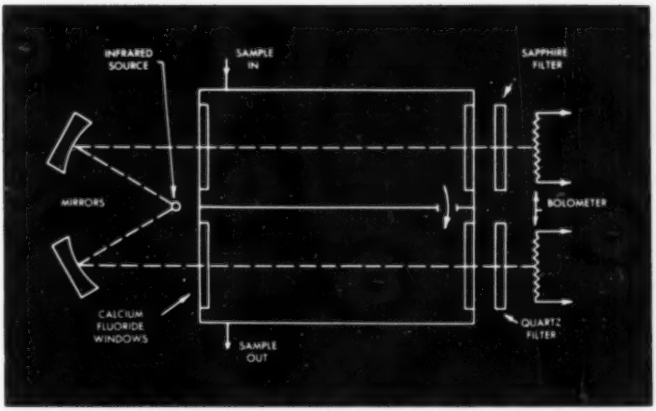


FIG. 1—Optical system for Phillips' automatic gas analyzer

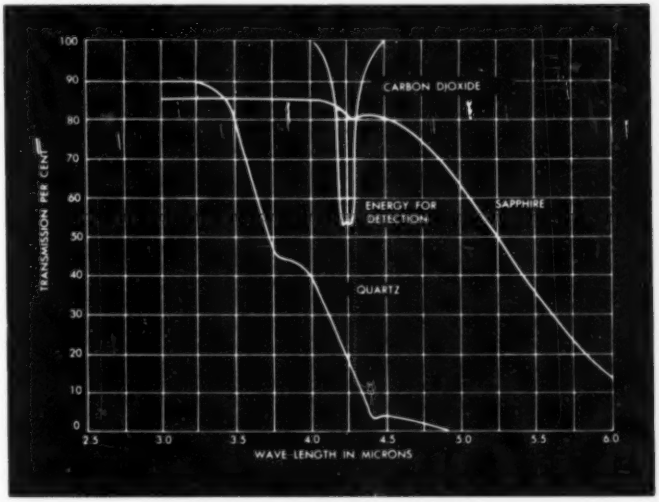


FIG. 2—Energy relationships for analyzing

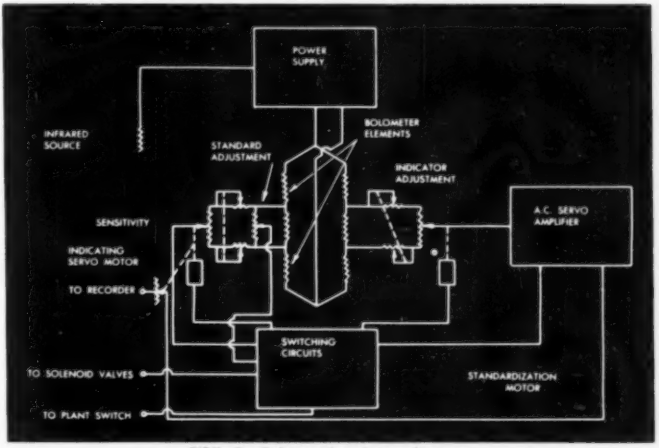
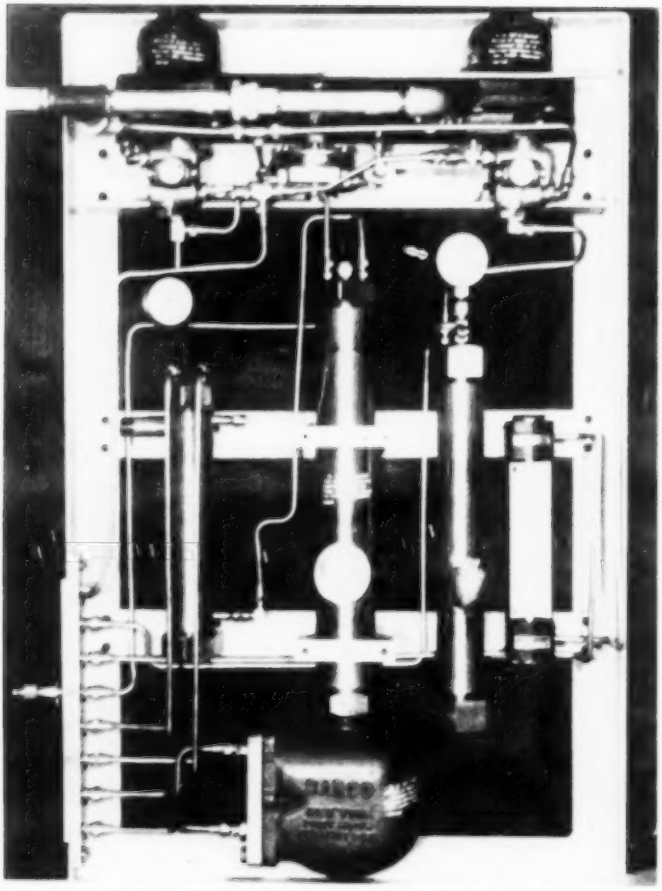


FIG. 3—Schematic wiring diagram



SAMPLING SYSTEM for the carbon dioxide analyzer

care went into the construction of a sampling system which would provide a clean sample at the proper temperature, pressure and flow to the instrument. A photograph of the completed assembly is shown above, and a schematic drawing of the sampling system is shown in Fig. 4.

The input to the system is tied to sample lines connected to plant air and to the regeneration effluent. Explosionproof solenoid valves operated by the timing circuit described above alternately allow either plant air or regeneration effluent to pass through the sampling system into the analyzer sample cell. The system is operated so that gas not being analyzed is vented at about the same flow rate as when being analyzed. Sample lines carry gas volumes in excess of those required by the instrument in order to assure samples with negligible time lags.

The regeneration effluent contains a large proportion of steam which is normally used in the regeneration cycle to control the rate of burning by dilution of the atmospheric air. To prevent water condensation in the instrument, the regeneration effluent is passed through a water-cooled heat exchanger (not shown in photo), a water drop-out tray, and a scrubber which reduces the water content to the equilibrium demanded by temperature and pressure. To further prevent this water from reaching the instrument, a connection is provided into the differential water trap which will allow the water to be drained while still maintaining gas pressure at the cell.

The differential water trap provides a sample cell pressure of about two inches of water above atmospheric pressure. Sample pressure is maintained constant by the pressure regulators. Flow is regulated by a flow controller and indicated by the rotameter. Since the atmospheric air is relatively clean and dry, it is humidified to saturation at about 5 psi. and 80° F. so that its water content will be essentially the same as that of the regeneration sample gas.

Calibration of Analyzer

The instrument was calibrated in the laboratory by flowing measured quantities of CO_2 and nitrogen into the sample cell. Flow was measured with rotameters which were calibrated to about ± 1% of scale. Some difficulty arose in measuring low percentages of CO_2 since the total flow rate through the instrument is around 2000 cc. per min. The calibration curve of the instrument as it left the laboratory is shown in Fig. 5 (upper curve) and approximates a logarithmic function.

It was found that recalibration in the field was desirable due to some differences between laboratory calibration samples and field sample in addition to atmospheric pressure differences. The method of field calibration consisted of taking several bomb samples of the regeneration effluent gas and at the same time recording the instrument readings. Analysis of the CO_2 content of the bomb samples was made on a conventional laboratory mass spectrometer. Previous to field calibration, the sensitivity was set by using a mixture of nitrogen and approximately 3 mol % of CO_2. Accurate CO_2 analysis of this gas was made on a mass spectrometer.

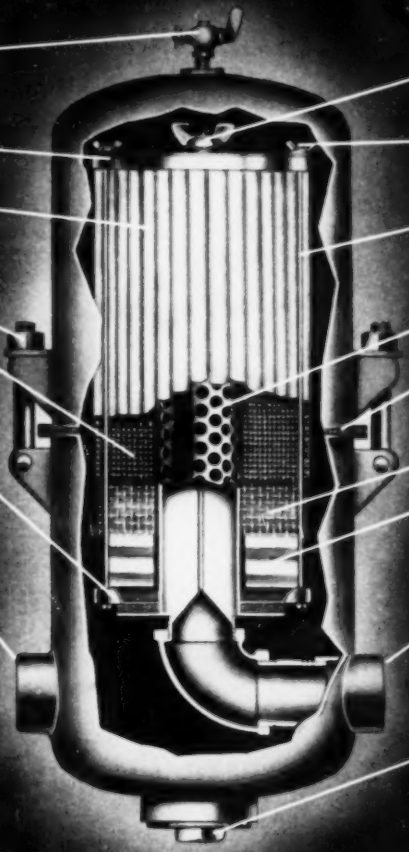
A 3% CO_2 sample was chosen because the instrument accuracy at the low end of the scale was of greater importance. The resulting calibration curve is also shown in Fig. 5 (lower curve). Although the laboratory calibration and plant calibration do not compare favorably in magnitude due to differences in the instrument sensitivity setting and cell presure, the shapes of the curves are very similar.

Concerning accuracy of the instrument, it should be borne in mind that absolute accuracy is not of prime importance as the instrument compares the CO_2 content of the regeneration effluent to the CO_2 content of the plant air.

Results

A typical chart record showing variation in CO_2 content during the regeneration cycle is illustrated in Fig. 6. The increase in CO_2 content at the end of the cycle is due to the reduction of the regeneration air to steam ratio. The analyzer senses the CO_2 to air ratio but not the CO_2 to steam ratio.

The most significant result arising from the installation of the instrument has been to furnish the process engineers and operating personnel a continuous and accurate record of CO_2. This was of interest particularly near the end of the regeneration



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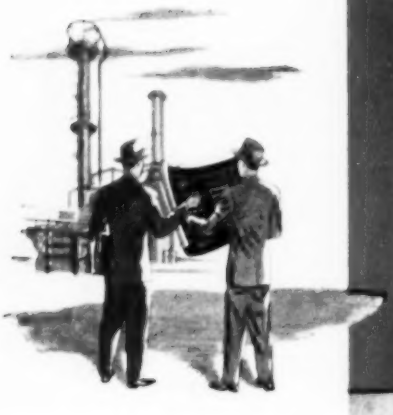

ACCENT ON ADAPTABILITY

Intelligent and experienced foresight often saves a plant from premature obsolescence.

In engineering and constructing The Neville Company's new solvent and naphthalene plant at Neville Island, Pa., the accent was wisely placed on *adaptability to a variety of operations.*

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period. It was found that Orsat readings had been rather poor in the region of 0.5% CO_2, due in part to poor accuracy of volumetric measurement and to numerous versions of the correct technique. Also, it has been found that intermittent sampling often leads to ambiguous interpretation of results.

This is best illustrated by the effect on the CO_2 content when a reduction is made in the amount of regeneration air added to the steam. The CO_2 content increases sharply, dropping off after a few minutes. This trend is shown in its true light by the analyzer, but a snap sample taken at the wrong time for Orsat analysis could give a very faulty impression of the progress of regeneration, and has resulted in unnecessary prolonged regeneration time. Furthermore, since a continuous record was obtained, it was possible to undertake experimental operation to determine the effect of regeneration utilizing higher temperatures near the end of the regeneration period and effect a considerable reduction in the remaining carbon or coke deposit on the catalyst. Latest estimates show that with the improvements in regeneration cycle operation, conversion during the process cycle has been increased from 3 to 5% at an average level of 35% conversion without sacrifice of efficiency. This indicates a direct increase of 8 to 14% butadiene output.

It has been shown that an infrared analyzer is an accurate indicator of CO_2 content, particularly at low concentrations. Since the particular instrument used is self standardizing, calibration should remain constant over long periods.

From an economic viewpoint, the instrument has provided process personnel with accurate, continuous records enabling them to determine more efficient operating conditions as well as eliminating 24 hour shifts of operating personnel performing Orsat analysis. Also, the release of technical personnel from shift work was hastened by providing a record of operation more easily interpreted by operating personnel. In the particular application cited, the benefits derived from the installation of the instrument are of such magnitude that the savings resulting from a few weeks operation would easily pay for the instrument.

Acknowledgement

This paper was prepared under the sponsorship of the Synthetic Rubber Division of the Reconstruction Finance Corporation.

The authors wish to thank the Phillips Petroleum Company engineers at the Instrument and Equipment Branch and at the Pilot Plant Experiment Station who have contributed their advice and assistance.

A large amount of the success of this application was due to the planning and operating cooperation of the process and operating engineers at the Plains Butadiene Plant, Borger, Texas.

The catalyst which was used in the experimental dehydrogenation process described above was manufactured by the Low Chemical Co. The equipment described in this report is covered by patent applications and disclosures.

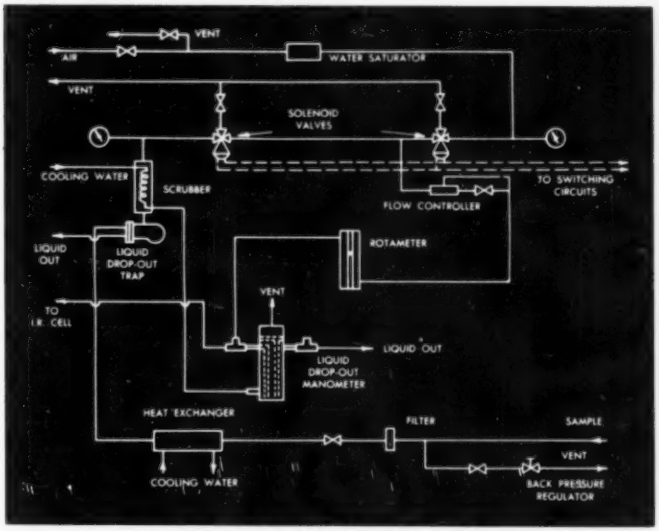


FIG. 4 Schematic of sampling system

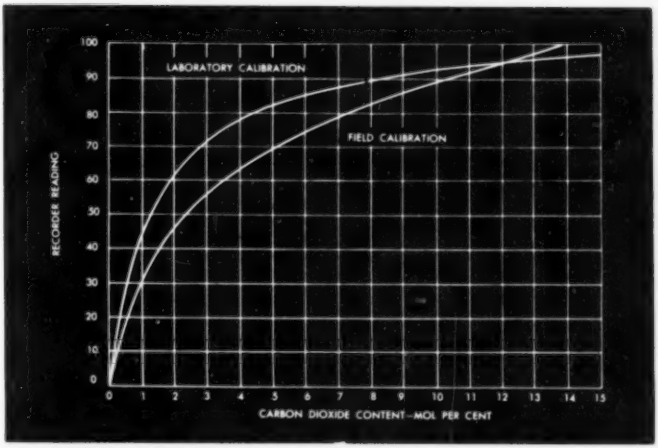


FIG. 5 Calibration curves for infrared analyzer

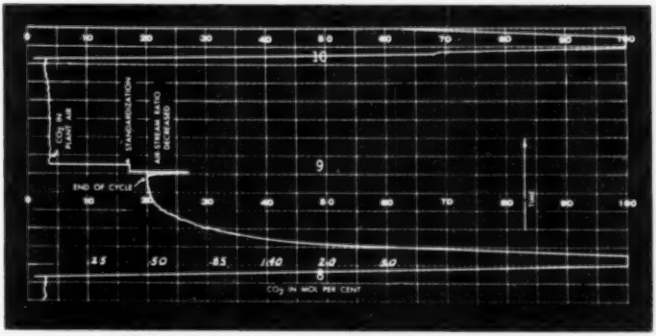


FIG. 6 Record of CO_2 content during regeneration

Canada Builds A New Empire

Over $100 million being invested in nine new petrochemical plants; two more expanding

PETROCHEMICALS are booming in Canada. By the end of next year the industry will have more than tripled its present size in terms of plants, machinery and equipment.

Four petrochemical plants are now in operation in the Dominion, with two of these being expanded. Nine new plants are under construction, at an estimated cost of over $100 million.

Center of this new industrial activity is the province of Alberta, with its recent oil and gas boom. Three of the new plants are being built there, two of them representing two-thirds of the new investment money being poured into the industry. Four of the new plants are going up in Quebec (Montreal area), and the remaining two are being built in Ontario.

Why all this hullabaloo about petrochemicals? The answer is quite simple. Canada's oil and gas reserves, the petrochemical lifeline, are in abundance due to recent "finds" and her natural resources haven't yet been fully developed.

Ninety-five per cent of Canada's oil and gas reserves are located in Alberta, the chief region of exploration to date. The remaining 5% are located in the lightly-explored Northwest Territories, Saskatchewan, Manitoba, and British Columbia.

Natural gas reserves are being boosted rapidly, particularly in Alberta where gas discoveries have been made in more than 125 different areas the past five years. Alberta's proved gas reserves are now estimated at between 8 and 12 trillion cu. ft., dependent upon the individual appraiser's rating of the many one-well gas strikes that haven't yet been fully evaluated.

Gross value of oil and gas reserves is now over $5 billion. Only 5% of Canada's 100,000 sq. miles of favorable geological territory has been fully evaluated, therefore the $5 billion dollar value is probably infinitesimal when one considers the country's full potential. To top this off, discoveries are now being made in areas that were once considered 'written off' as exploratory failures.

America's four greatest oil states, Texas, Oklahoma, California, and Louisiana, could be placed inside Western Canada's known and potential oil and gas belt, and still leave plenty of territory uncovered. The intensity of exploration in Western Canada to date is only about 1% of the intensity to date in these four American states.[1]

A look at investments and investment returns since 1946 gives an indication of what the petrochemical industry has brought to the expanding economy of Canada. For 20 years until 1946 an average of about $5 million was invested annually in Canadian chemicals. Suddenly in 1946 that figure was upped to $19.6 million. Years of study and market research by Canadian officials attribute this increase to the potential manufacture and sales of petrochemicals. In 1948 the investment rose to $41.9 million; in 1951 the figure was placed at $49.6 million. A record total of $122.1 million in capital expenditures will be reached this year for expansion of the chemical products industries according to the latest estimates of the Department of Trade and Commerce.[2] About 80% of this will go or has gone into petrochemical expansion.

This brief description of Canada's growth and potential gives us some of the reasons why that country has bright hopes for the future. Alberta looms as the best bet to become Canada's greatest industrial province, because of oil and gas developments and their by-products.

New Petrochemical Plants[3]

Canadian Chemical Co. Ltd., a Celanese affiliate, is now constructing a $55 million plant at Edmonton, Alberta, to turn out a broad range of petrochemicals. (See PETROLEUM PROCESSING, "Petrochemicals for Canada," July 1952, pp. 987-989). Raw materials come from refinery gases of Edmonton refineries. The hydrocarbons from these refinery gases are then processed into the following petrochemicals: methanol, n-propanol, n-butanol, formaldehyde, acetaldehyde, acetone, acetic acid, propylene glycol, pentaerythritol and other organic chemicals. Ten million lbs. of staple fiber are to be produced annually, and 5 million lbs. of filament yarn yr. These last two products will probably be exported to Celanese plants in Mexico and South America. It is thought that because of high custom's duty, yarn and fiber would have difficulty in competing in U. S. market. (In July 1951, producers of yarn and staple in the U. S. held only 25,000,000 lbs. At the end of July 1952, they held 81,000,000 lbs.) Other chemicals produced here will be sold for Canadian consumption. The United States will probably receive those chemicals above Canadian requirements.

(*Exports of chemical and allied products to the United States from Canada in* 1951 *amounted to* $67 *million, or nearly* 52% *of the total shipped to all foreign countries. Imports rose about* 28% *to* $191.8 *million, and* 86% *of all imports came from the United States.*)[4]

Canadian Industries Ltd. is building a $20 million plant at Maitland, Ontario, to produce nylon intermediates. It is now under construction and is expected to be completed in the summer of 1953. CIL is presently importing cyclohexane from the United States. From the cyclohexane they will make adipic acid, one of the constituents of nylon. They will also make hexamethylene diamine, also used in nylon manufacture, from adipic acid. The process is patented by Du Pont.

Canadian Industries Ltd. is also building a petrochemical plant at Edmonton, Alberta. Using 10 million cu. ft./day of natural gas, CIL will produce polyethylene for Canadian markets.

Shell Oil Co. of Canada Ltd., is spending $3 million for a petrochemical plant at Montreal for the production of isopropyl alcohol and acetone. They will employ the same process used in their plants in the U. S. They intend to produce 13.5 million lbs. of isopropyl alcohol and 7 million lbs. of acetone annually. (Alcohol figure does not include alcohol used in making acetone). Propylene will be used as the raw material, being obtained from refinery by-product gas. Products are intended for Canadian markets. Completion is scheduled for the end of 1952. C. F. Braun & Co. is the contractor.

B. A.-Shawinigan Ltd., a joint corporation of the British-American Oil Co. and Shawinigan Chemicals Ltd., is building a $3-4 million phenol-acetone plant in Montreal. The process is being licensed by Hercules, whereby cumene is oxidized to either phenol or acetone. The plant is under construction now and is expected to be on stream by the end of the year. Plans call for the annual production

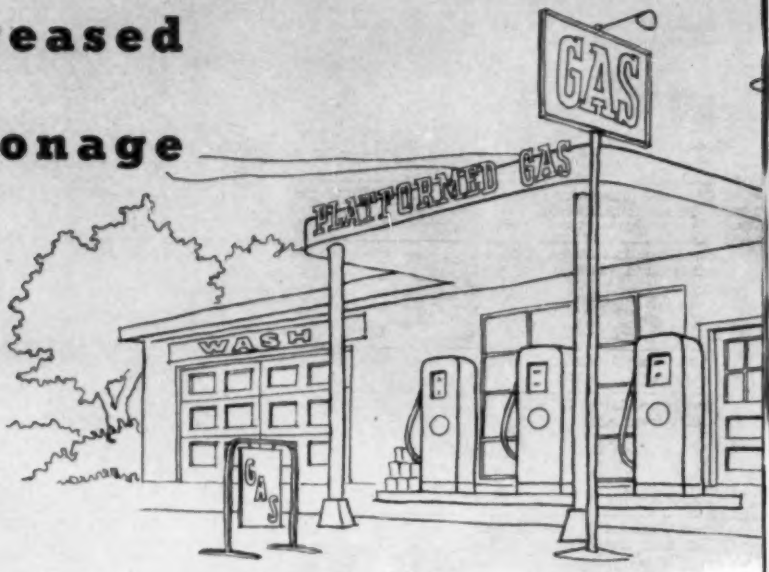
Petrochemical Plants in Canada

Company and Location	Hydrocarbon Raw Materials	Products	Remarks
B. A.—Shawinigan Ltd. Montreal, Quebec	cumene	phenol, acetone	Cost, $3 million; to be completed end of 1952; 13 million lbs. of phenol expected capacity; Contractor, Canadian Kellogg Co. Ltd. Joint venture of British-American Oil Co. and Shawinigan Chemicals Ltd.
Cabot Co. of Canada Ltd. Sarnia, Ontario	liquid hydrocarbons	high abrasion and fast extruding furnace blacks	Cost, $2 million; Contractor, Stone & Webster; expected completion this year
Canadian Chemical Co. Ltd. Edmonton, Alberta	refinery gases	formaldehyde, acetaldehyde, propionaldehyde, acrolein, propylene oxide, methanol, acetone, acetic acid, n-propanol, propylene glycol, dipropylene glycol, and mixtures of heavier aldehydes, oxides, alcohols, and ketones	Cost, $55 million; Contractor, Brown & Root, Inc. of Houston
Canadian Industries Ltd. Edmonton, Alberta	natural gas	polyethylene	Cost, $13 million; 10 million cu. ft./day of natural gas raw materials
Canadian Industries Ltd. Maitland, Ontario	cyclohexane	nylon salts	Cost, $20 million; to be completed by summer 1953; CH_4 is presently controlled by du Pont and Britain's Imperial Chemicals
Consolidated Mining & Smelting Co. Calgary, Alberta	natural gas	ammonia, ammonium nitrate	In operation for the past 10 years
Dominion Tar & Chemical Co. Ltd. Montreal, Quebec	ethane, ethylene	ethylene oxide, ethylene glycol	Cost, $5 million; raw materials to be obtained from refinery gases from McColl Frontenac and Shell Oil refineries nearby; contractor, Stone & Webster
Dow Chemical Co. of Canada Sarnia, Ontario	refinery gases	ethylene oxide, ethylene glycol, styrene, other organic chemicals	In operation for three years; obtains refinery gases from Polymer Corp.
Dow Chemical Co. of Canada Sarnia, Ont.	refinery gases	ethylene	Refinery gases to be supplied by Canadian Oil Co. at Sarnia.
Polymer Corp. Sarnia, Ontario	refinery gases	butadiene, styrene, synthetic rubber	Refinery gases supplied by Imperial Oil Ltd.; existing plant
Polymer Corp. Sarnia, Ont.	refinery gases	butadiene, styrene, synthetic rubber	Increasing existing plant facilities by 25%
Royalite Oil Co. Turner Valley, Calgary, Alberta	natural gas	sulfur	Cost, $250,000; capacity 30 long tons/day; to be completed 1952; contractor, Foster-Wheeler
Shell Oil Co. of Canada Ltd. Montreal, Quebec	refinery gases, propylene	isopropyl alcohol, acetone	Cost, $3 million; capacities, isopropyl alcohol 13,500,000 lbs./yr.; acetone, 7 million lbs./yr.; contractor, C. F. Braun & Co.
Shell Oil Co. of Canada Ltd. Jumping Pound, Alberta	natural gas	sulfur	Cost, $500,000; now operating; capacity, 32 long tons/day
St. Maurice Chemicals Varennes, Quebec	refinery gases	formaldehyde, pentaerythritol	Cost, $2 million; owned by Shawinigan Chemicals Ltd. and Hercules Chemical Co.; capacities, formaldehyde, 30 million lbs./yr.; pentaerythritol, 3 million lbs./yr.

it's a matter of record...

PLATFORMING

has increased our gallonage



"Our jobbers have stepped up their gallonage since they've been delivering Platformed gasoline. And no wonder — at the rate the stations have been pumping it!"

That's a typical expression from refiners' sales managers who are now supplying direct and jobber outlets with Platformed gasoline. And the reason for this sales surge is no secret.

It's performance. Platformed gasoline has proved its superiority under all kinds of driving conditions and in all types of automotive engines. Motorists have tried it—liked it—

recommended it . . . and their preference has been evidenced in the growing sales volume over the past three years.

Increased gallonage is one of the important reasons why it pays to choose Platforming—the *proved* reforming process. It's a matter of record.

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Universal Service Protects Your Investment

NO SIZE LIMITATIONS ON *Gradiation* HEATERS

Selas Gradiation Heaters have been designed to cover the range from Pilot to Plant scale capacities.

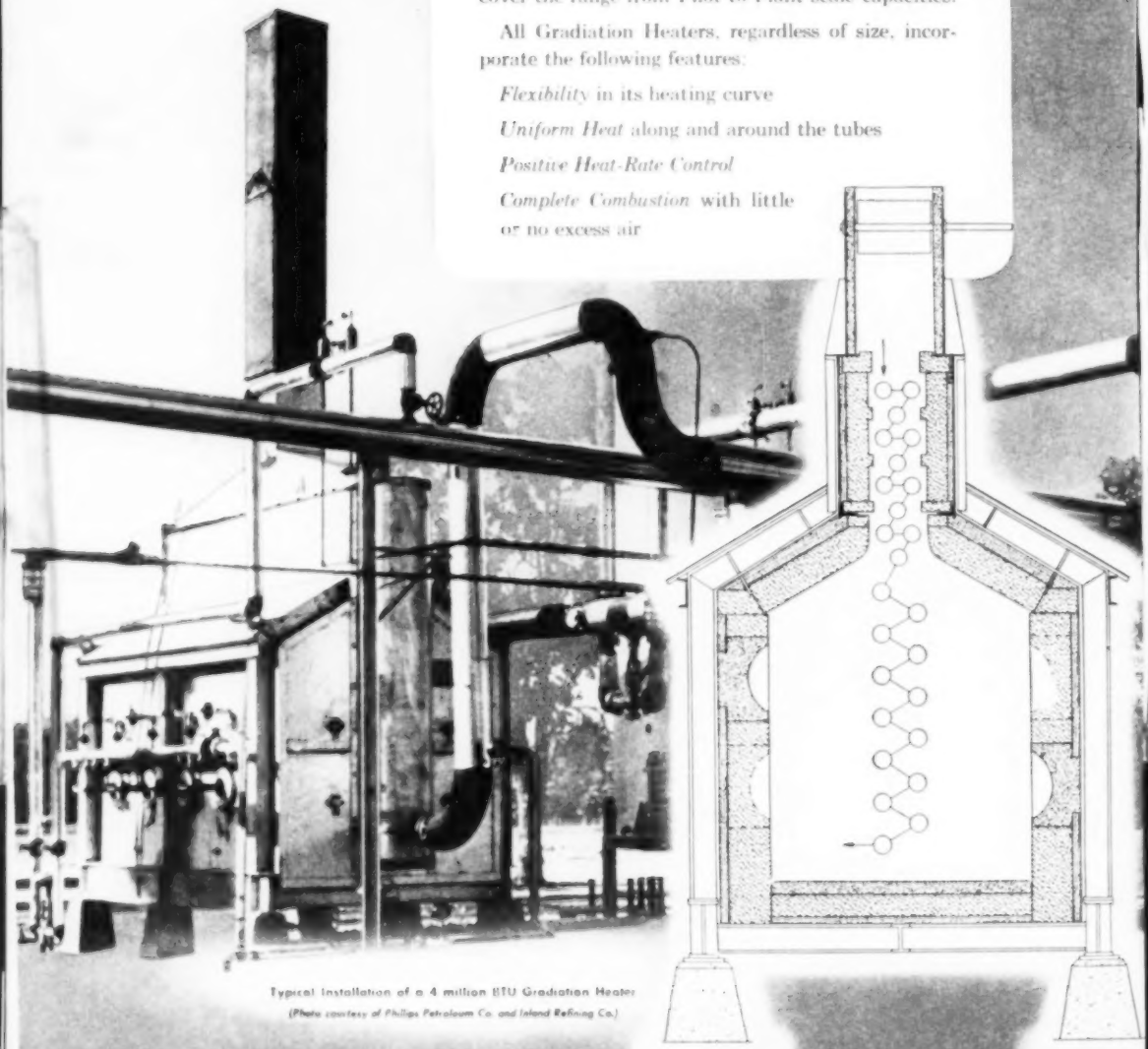
All Gradiation Heaters, regardless of size, incorporate the following features:

Flexibility in its heating curve

Uniform Heat along and around the tubes

Positive Heat-Rate Control

Complete Combustion with little or no excess air



Typical Installation of a 4 million BTU Gradiation Heater
(Photo courtesy of Phillips Petroleum Co. and Inland Refining Co.)

SELAS CORPORATION OF AMERICA

PHILADELPHIA 34, PENNSYLVANIA

Heat Processing Engineers for Industry — Development • Design • Manufacture

of 13 million lbs. of phenol. Canadian Kellogg Co. Ltd. is handling construction and design.

Dominion Tar and Chemical Co. Ltd. is building a $5 million ethylene oxide and ethylene glycol unit in Montreal. They will use ethane and ethylene as raw materials, obtained from by-product gases of nearby McColl Frontenac and Shell Oil Co. refineries. Chlorine will be supplied from their plant in Beauharnois, Que. Stone and Webster are handling construction. Ethylene oxide is to be marketed as an essential raw material in the manufacture of synthetic detergents; 80% of the ethylene glycol will go for anti-freezes in Canada. The other 20% of ethylene glycol is for defense purposes and will also find some use as a soft-ner for cellophane, as well as high explosive ingredients, used in place of glycerine.

Cabot Carbon of Canada Ltd. is constructing a $2 million carbon black plant at Sarnia, Ont. The plant will be operated using liquid hydrocarbon raw materials instead of traditional natural gas raw materials. Cabot will obtain these raw materials from U. S. refineries until "Canadian refineries can supply the proper quality and type of highly aromatic liquid hydrocarbons."[10] They will make "HAF" high abrasion furnace blacks for the Canadian rubber industries, and "FEF" fast extruding furnace blacks. The U. S. dollar now required for carbon black imports will be reduced by about $2 million when the plant is in full production. It is expected to be producing this year. The plant is being erected by Stone & Webster Canada Ltd. according to designs prepared by Cabot Engrg. Co., Tampa, Tex.

St. Maurice Chemicals, owned jointly by Shawinigan Chemicals Ltd. and Heyden Chemical Co., is building a plant on the outskirts of Montreal at Varennes, Quebec. It will manufacture 30 million lbs./yr. of formaldehyde and 3 million lbs./yr. of pentaerythritol from refinery gases obtained from nearby refineries. Construction was started in the spring of 1952.

Royalite Oil Co. is constructing a sulfur recovery plant from natural gas in the Turner Valley, Calgary, Alberta. Foster-Wheeler is the contractor and completion is expected this year. Projected capacity is 20 long tons/day. Investment is estimated at $350,000.

Existing Petrochemical Plants[11]

Shell Oil Co. of Canada Ltd. recently completed a $500,000 sulfur recovery plant at Jumping Pound, Alberta. Fluor handled the engineering details. Plant is currently producing 32 tons/day of elemental sulfur, using natural gas as raw material.

Dow Chemical Co. of Canada is located at Sarnia, Ontario, and has been in operation for about three years. Products are ethylene oxide, ethylene glycol, styrene and other organic chemicals from refinery gases obtained from Polymer Corp. after Polymer uses the gases to make butadiene and styrene for synthetic rubber. Canadian Dow processes are based mainly on ethylene. Carbon tetrachloride is another of their products. Much of Dow's styrene is turned over to Polymer Corp. for synthetic rubber manufacture. The remainder is used for making plastics.

Dow is constructing a new ethylene plant at Sarnia since present quantities do not supply the demand. Additional refinery gases for ethylene manufacture will come from Canadian Oil Co. at Sarnia.

Polymer Corp., also in Sarnia, is expanding capacity of their plant there for an additional 25% production of synthetic rubber. Supplier of refinery gases to Polymer is Imperial Oil Ltd.

Consolidated Mining and Smelting Co.'s plant at Calgary, Alberta, for the past 10 years has been making ammonia from natural gas.

Room for Pioneering

In northern Alberta, there is a large deposit of tar sands which contain vast quantities of oil. While an economic method of extracting the oil and other ingredients has not been put into operation, research continues and Canadian economists and "petrochemical pioneers" feel that further development of the area will be made in the next few years.

Many Canadian entrepreneurs believe that the second half of the twentieth century will be "Canada's Half Century" just as the first half was featured by the United States' tremendous advancement in business and world leadership, and the nineteenth century era of great expansion of the British Isles.[12]

References

(1) Foreign Service Despatch No. 128, Dec. 6, 1951, Dept. of State, United States, and released through the U. S. Tariff Commission.

(2) An address before the New York Society of Security Analysts, February 7, 1952, by Carl O. Nicaise, Member of Parliament for Calgary West, and publisher of the *Daily Oil Bulletin*, of Calgary, Alberta.

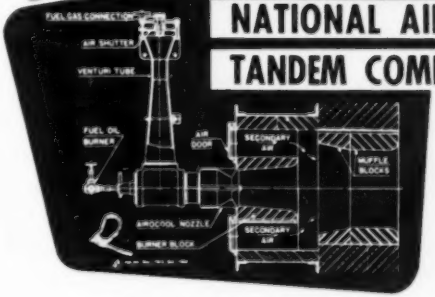
(3) Correspondence from The Royal Bank of Canada, Calgary, Alberta.

(4) Canadian Chemical Processing, "Our Petrochemical Age," Vol. 36, No. 8, p. 5, (Nov. 1952).

(5) *Canadian Chemical Processing*, "Scoreboard on Chemical Production," by H. F. McLeod, Vol. 36, No. 6, pp. 10-16, (June 1, 1952).

The *Exclusive*

NATIONAL AIROIL OIL-GAS TANDEM COMBUSTION UNIT



HERE'S WHY

... because the NATIONAL AIROIL "Airocool" Tandem Unit is more than just combustion equipment. It is an exclusive Combustion System which has proved many more hours "on stream" without shutdown.

"Airocool" Tandem Combustion Units fluxing dirty refinery gas, uncut asphalt, refinery fuel oils hold hot air in the combustion zone until fuel and hot air are mixed thoroughly. This means that combustion takes place in a hot zone; the result ... increased combustion efficiency with a minimum of excess air.

NATIONAL AIROIL Tandem Units add up to 16% further flame travel without extending the furnace front ... eliminating flame impingement on bridge wall and tubes, allowing longer life for those elements ... and because of this added flame length secondary air is controlled easily and accurately.

The Tandem Unit is popularly fired with NATIONAL AIROIL Combination Oil and Gas Burners. YOU will realize higher profits from YOUR heaters when Tandem Combustion Units are specified. Detailed literature sent upon request on your business letterhead.

CHEMICAL-PETROLEUM DIVISION

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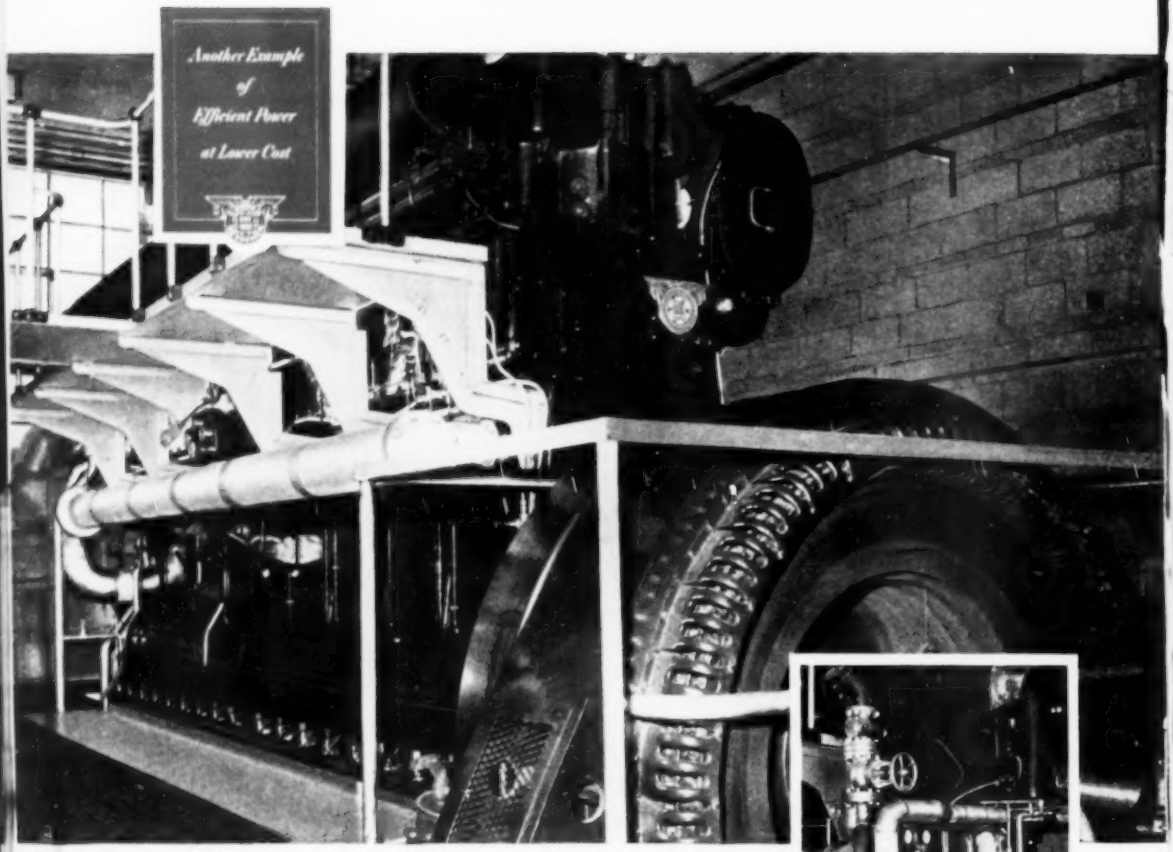
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

(To obtain more data on advertised products see page 1511)



Latest of three Cooper-Bessemer LS-8 diesels in International Latex plant, this supercharged 1700 hp unit provides 40% thermal efficiency. End view at right shows piping setup for jacket water heat recovery contributing to 80% over-all thermal efficiency.

How they stretch dollars at International Latex

● Here's a diesel plant that is turning in amazing results—*80% over-all thermal efficiency!* The engine is a Cooper-Bessemer supercharged LS-8, installed in the International Latex plant at Playtex Park, Dover, Delaware.

To start with, this modern LS diesel exceeds 40% thermal efficiency—performance rarely equalled! On top of that, an ingenious jacket water heat recovery system captures for processing use another 40% of the total heat input.

In all there are three Cooper-Bessemer LS-8's in this International Latex plant—the supercharged unit shown above and two previously installed atmospheric LS-8's. Later on these original LS-8's can be easily converted to supercharged operation to boost their output and to match the remarkable efficiency of the new unit.

Whatever your power needs may be, check with Cooper-Bessemer. Find out how much you stand to save by the best to be had in efficiency and long, trouble-free engine life.

The
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MOUNT VERNON, OHIO — GROVE CITY, PENNA.

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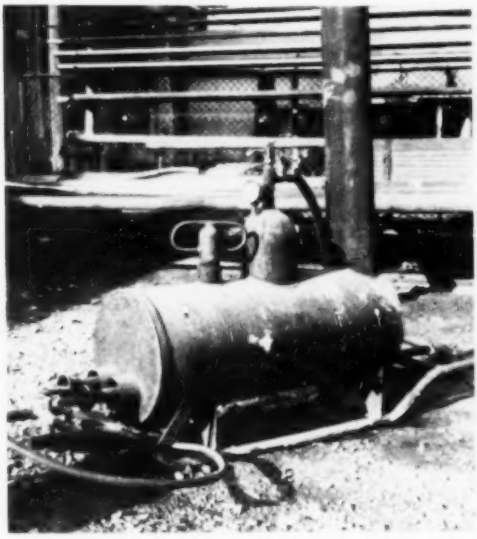
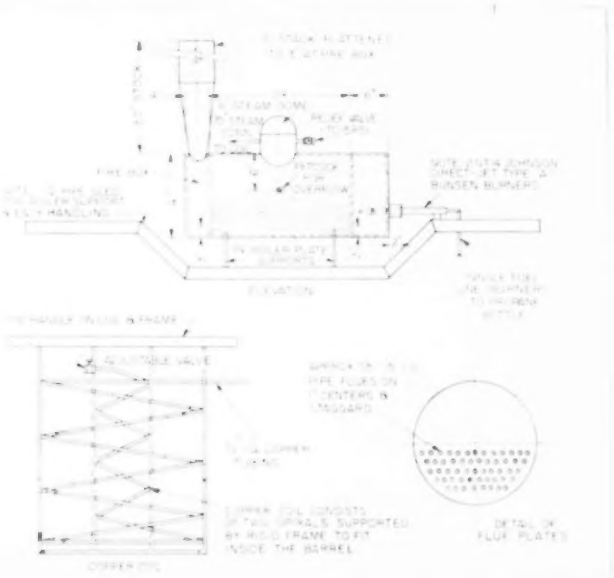


PORTABLE boiler unit on skids

AUXILIARY copper steam coil

Portable Boiler Useful in Field



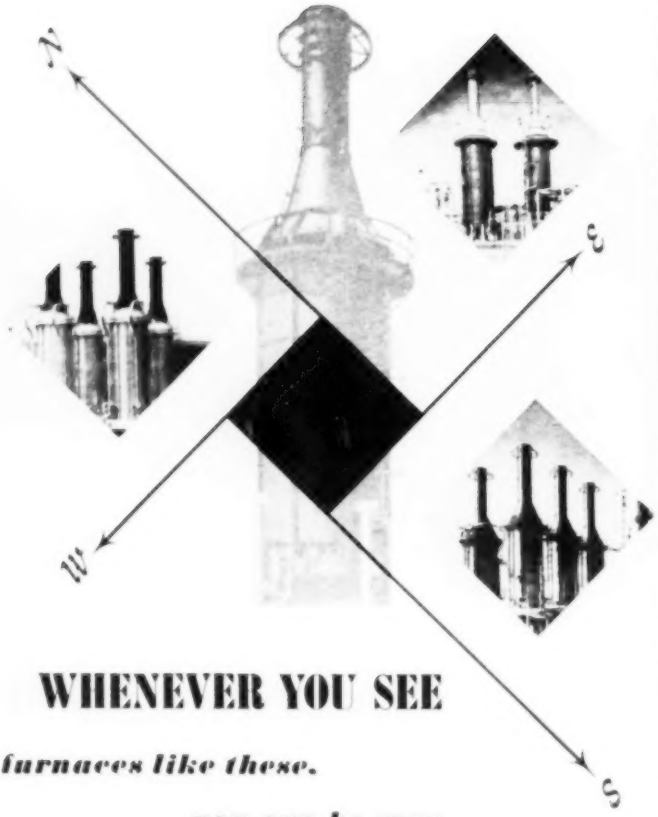
CONSTRUCTION DETAILS of the portable field boiler and coil

ALTHOUGH the light-weight, portable boiler and auxiliary steam coil shown in the illustrations was made by Socony-Vacuum welders primarily for heating pipeline cement, it can be used on many other field jobs—such as steaming small tanks and drums before welding, steam-cleaning motors and motor parts, or any application where a small volume of steam is wanted.

Of horizontal design and propane-fired, the boiler is constructed of 11-ga., or approximately ⅛-in., steel, weighing about 5 lbs./sq. ft. It has 55 flues of ½ in. I. D. and 1/16 in. wall, and it holds approximately 8½ gal. water. It is fitted with a 15 psi. relief valve, pressure gage, steam outlet, bottom drain cock, water level cock on the side, and a top opening for filling. The unit is fired by two propane-burning, Johnson Jet burners, fitted with suitable regulators, each burner capable of producing 26,000 Btu.

Steam can be produced in 25 to 30 minutes, using both burners. One burner is then sufficient to hold. Greater efficiency could be obtained by adding insulation.

The steam coil, used for heating the cement in open top drums, is constructed so that there is no area in the drum greater than three inches not covered by the coil. The coil is cased in a rigid skeleton frame of 1 x ¼ in. strap iron. All-welded



WHENEVER YOU SEE

furnaces like these,

you can be sure

they're* PETRO-CHEM ISO-FLOW *design

More than **1000** *are in operation throughout the world in the petroleum, chemical and allied industries . . . for all processes and for any duty, pressure, temperature and efficiency . . . and all Petro-Chem Iso-Flow furnaces are pre-eminently satisfactory.*

PETRO-CHEM ISO-FLOW FURNACES

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INCORPORATED

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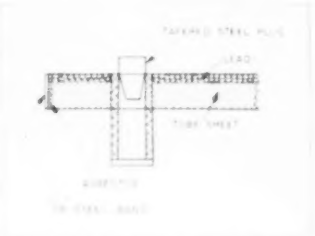
Representatives: Bethlehem Supply, Tulsa and Houston · Flagg, Brockett & Durgin, Boston · D. D. Foster, Pittsburgh · Faville-Levally, Chicago · Lester Oberholtz, California · Gordon D. Hardin, Louisville, Kentucky

construction has been used in both the coil and the boiler.

The unit was built by and won a substantial award in Socony-Vacuum's suggestion system for John Bornholdt, pipeliner, and A. A. Kauffman, welder, at Socony's Topeka, Kans., shops.



HOW LEAD PROTECTS tube sheets against excessive wear and corrosion

How to Get Longer Life From Heat Exchangers

PROLONGED service life is being obtained for heat exchangers by the maintenance department at the Philadelphia refinery of Atlantic Refining Co. through the use of a simple and rapid lead-burning technique.

In one case, the company reports savings of $1100 per bundle over the cost of a new exchanger. Nine bundles have been salvaged so far in that instance. The lead is used to protect badly worn tube sheets on the water side. The method is illustrated in the accompanying sketch. The procedure is as follows:

1. Exchanger is placed in a vertical position. (Lead burning is done in the flat position.)

2. The area to be leaded is sandblasted and then immediately covered with soldering paste.

3. A 1-16-in. band of steel, to serve as a mold, is wired around the edge of the tube sheet with an asbestos gasket between the band and the edge of the sheet. The band should extend above the tube sheet to the desired thickness of the lead.

4. The surface of the sheet is tinned.

5. Tapered steel plugs are placed in tube openings in the lead burning areas. About a dozen plugs is sufficient.

6. Lead is overlayed on the entire corroded surface, care being taken to make a positive union with both tube sheet and tubes. Lead thickness laid down should allow for final machining.

7. The band and plugs are removed and the surface machined to the desired final thickness.

(To obtain more data on advertised products see page 1344)

TINY DOZER pushes muck into pile so . . .

CLAM SHOVEL can easily scoop it out

Bulldozer Gives Shovel an Assist

By HERBERT S. FOURER*

A SOMEWHAT novel method of cleaning out sediment accumulations in one of its oil separators was employed recently at the Marcus Hook, Penna., refinery of Sinclair Refining Co. It involved the use of a small bulldozer, whose overall dimensions are only 38 in. wide, 41 in. high, and 6 ft. long.

Approximately 3000 cu. yds. of sedimentary deposit had accumulated in the 100 ft. wide by 200 ft. long by 7 ft. deep separator over a period of three years. The problem of removal was made difficult by the inability to depress a clam type power shovel so as to reach all sections of the separator. Furthermore, attempts to force the sediment by water streams from hoses to a point where the shovel could reach it were unsuccessful. Manual labor, of course, would have entailed a considerable expense.

It was then decided to adapt the small bulldozer—manufactured mainly for use on nurseries, golf courses, and landscaping—to the job at hand. The little dozer easily pushed the sediment to a convenient spot where it was then scooped up by the power shovel.

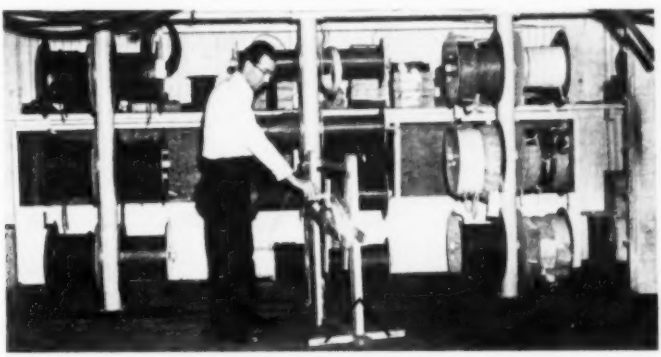
The entire job was completed in about 10 days. Manual labor would have consumed an estimated 8000 manhours, as compared to 80 manhours using the dozer. Obviously, the cost of the dozer was quickly paid off. Since that time, the dozer has been employed profitably in snow removal, back-filling pipe trenches, spreading clay, and on small grading jobs.

* Mr. Fourer is process engineer at Sinclair Refining Co., Marcus Hook, Pa.

IDEAS—Wanted!

Want cold, hard cash for your own maintenance ideas? PETROLEUM PROCESSING will pay at regular space rates—or more if your idea is a really hot one. So why not take a look around the shops or refinery. Then send in your stuff to us, along with illustrations, etc. Don't worry about the appearance; we'll dress up the drawings. Send contributions to:

Plant Practices Editor
PETROLEUM PROCESSING
1213 West Third St.
Cleveland 13, Ohio



How to Handle Electric Wire Fast

IT was a nuisance when coils of wire became unwound and tangled on the shelves of Shell Chemical's stores department at Shell Point, Calif.

So Kenneth Blair, a clerk, thought up a new system for storing and handling electric wire. The coils are now slipped on spools which are bolted to two sides of several stanchions. Between six and eight spools are attached to each stanchion. A spool can hold three 500-ft. coils of No. 12 wire. It's easy to roll the wire off the spool, feed it through a measuring device and dispatch it.

Result: Space is saved (only one-third the former space is needed), and delivery has been speeded for more efficient maintenance.

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Offers an extensive line of oxygenated solvents and chemicals

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The solvents and chemicals sold under the ENJAY* Oval Trade-Mark are outstanding for high quality and dependability. Every day more industries are calling on the long experience of the Enjay Company . . . making greater use of the diversified line of solvents and chemicals marketed by Enjay to increase product quality.

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ENJAY markets this wide range of industrial chemicals:

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Methyl Ethyl Ketone
Ethyl Ether
Isopropyl Ether
Diisobutylene
Polypropylenes
Butadiene
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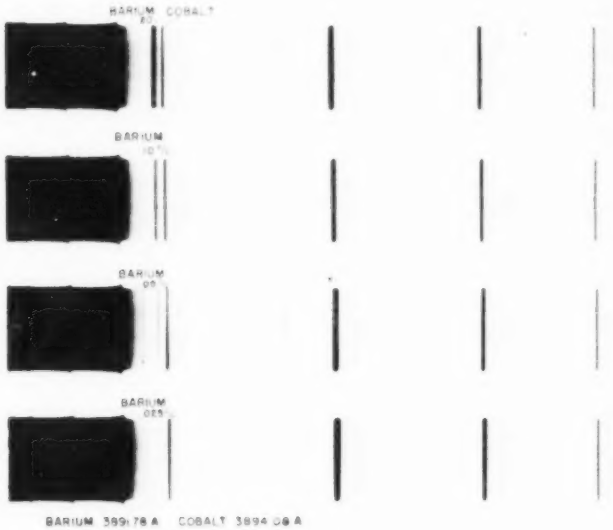


TYPICAL SPECTROGRAM showing analysis for barium

How To Save Time Analyzing Lube Oils for Metal Additives

By H. D. VELDHUIS, S. COHEN, and G. A. NAHSTOLL*

A TIME-SAVING and accurate spectrochemical method for determining metallic additives in new lube oils and metallic additive and wear elements in used oils has been developed by the Quality Laboratory, Manufacturing Staff, Ford Motor Co.

Complete analysis of one sample can be made in less than a half-hour. Other spectrochemical methods require two to three hours. Chemical analysis requires as much as two days on some elements, particularly where ashing of the oil is necessary. Many varying procedures have been developed in recent years for a rapid and accurate method. Each has its good points for the application for which it was intended. Many were tried at Ford, but it was found necessary to improve them for application to automotive problems.

The new technique uses the common procedure of making the sample homogeneous, placing the oil in a hollowed carbon rod, sparking the sample in the conventional manner, and microphotometering the suitable lines. The unusual step in the procedure is to absorb the oil into a filter paper disc which is inserted in the end of the carbon rod.

Electrode preparation: Electrodes, 1 in. in length, are cut from ¼-in. special carbon spectroscopic rods. A cavity, ⅛ in. in diameter and ⅛ in. deep, is machined on one end. A pellet of filter paper, ⅛ in. in diameter and ⅛ in. thick, is punched from a Whatman ashless tablet with a die and inserted into the cavity in the carbon electrode. The upper electrode is prepared by machining a conical point (90° included angle) on the end of another 1-in. carbon length.

Sample preparation: The oil sample is prepared by first heating it to 60° C. It is then agitated to give a homogeneous mixture. The standard and the sample tested must be approximately the same viscosity to insure equal size samples. If the sample is more viscous, it may be diluted with new oil which does not contain the elements for which the analysis is being made. A correcting factor is then necessary for the final percentage.

Equipment required: The excitation source should have the following specifications:

Peak voltage	25,000 volts
Capacitance	0.005 microfarads
Inductance	400 microhenries
Secondary resistance	3 ohms
R. F. current	4.5 amps.
A.C. interrupter	12 breaks/half cycle

The spectrograph is an Applied Research Laboratories design, with one and one-half meter grating.

The microphotometer is a projection type, made originally by the Engineering Research Dept. of the University of Michigan, and now made by Leeds & Northrup Co.

Procedure: The carbon electrodes are placed in the holders and spaced to ⅛-in. gap (upper electrode is the 90° conical point and lower electrode contains the filter paper pellet.) A drop of freshly agitated oil sample is applied to the pellet, being measured from a pipette.

In some cases, where the oil sample varies in viscosity, the drop must be added while the electrode is on a balance to weigh accurately the amount or the corrections made as noted above under sample preparation.

The sample then is sparked immediately with the following exposure conditions:

Spectrum range	2200-4200 angstroms
Slit width	45 microns
Lens in front of slit	4 inches
Pre-burn	None
Exposure time	10 seconds

The film is processed under these conditions:

Emulsion: Eastman Spectrum Analysis No. 1.

Developer: Eastman D-8, diluted with equal quantity of water. Time 45 seconds; temperature, 72°.

Hardener: 20% solution of chrome alum.

Wash: running water for 10 seconds.

Fixer: X-ray rapid fixer, 35 seconds.

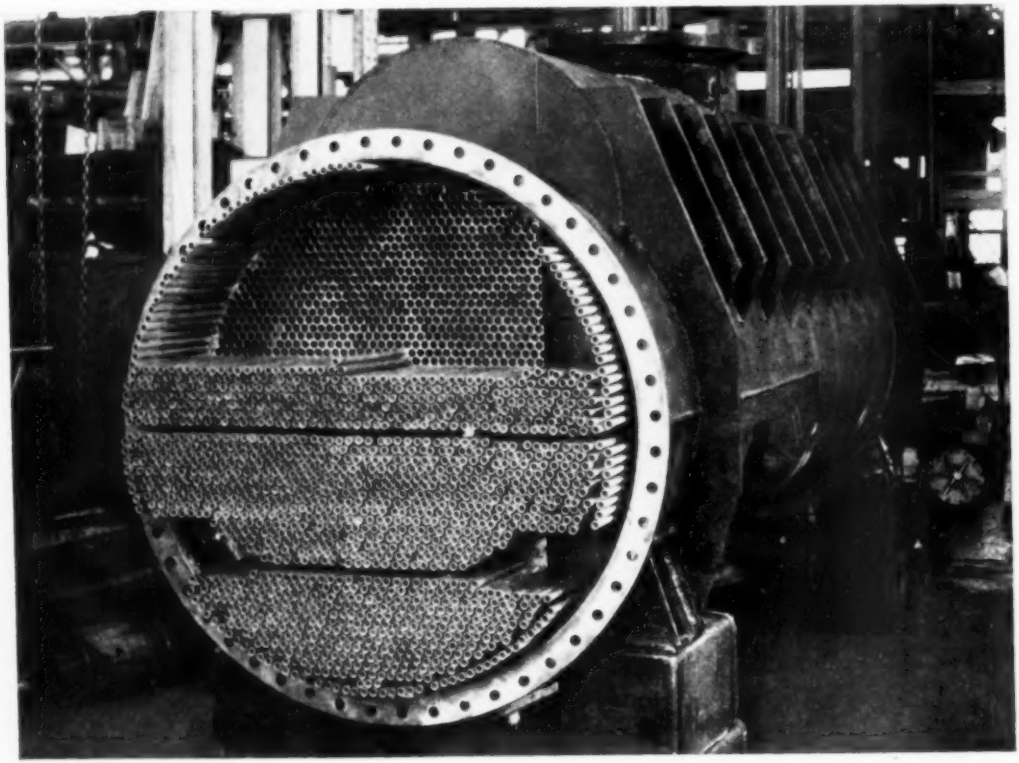
Wash: running water for 60 seconds.

Drying: resistant type heater with air blowing across emulsion.

After the film is processed, the various lines are microphotometered and the percentages of the elements determined by calculation. The contrast of the emulsion can be determined by any approved method. In

* Messrs. Veldhuis, Cohen, and Nahstoll are associated with the Ford Motor Co., Dearborn, Mich., in the Quality Laboratory, Manufacturing Staff.

They're ANACONDA tubes—placed in new Gulf installation



When this partially assembled heat exchanger was completed, it was installed as the surface condenser for a new vacuum still recently completed at Gulf Oil Corporation's Port Arthur, Texas refinery. The condenser was built by the Kewanee-Ross Corp., for M. W. Kellogg Co., the designing engineers and contractors.

Kellogg engineers appointed ANACONDA Admiralty Tubes for this particular equipment for one of the country's largest and most modern refineries. Tube dimensions are ¾ in. O.D. x .065 in. x 16 ft. long. The tube sheets are ANACONDA Naval Brass 56¾ in. diam. x 2 in. thick.

What alloy should you specify for your heat exchanger tubes? It all depends...on cooling water characteristics...on operating conditions . . . on many factors. But for sound counsel on the most economical alloy for your specific installation, draw on Anaconda's broad technical experience in all types of heat exchanger and condenser operation problems. Our Technical Department's services are always freely available to your technicians. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

for efficient heat transfer **ANACONDA** heat exchanger tubes

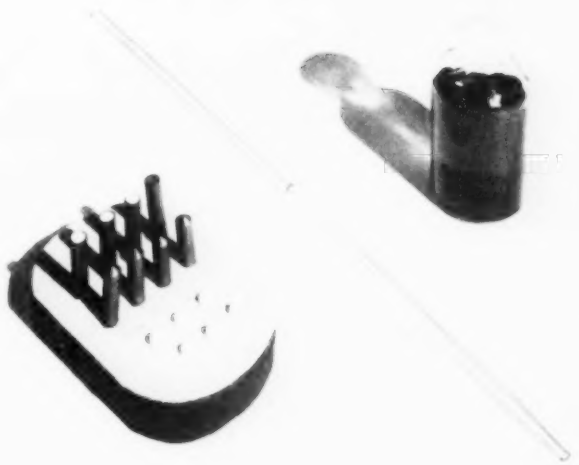
this case a set of iron lines of varying densities are used.

Internal standard of cobalt added as cobalt naphthenate to both standard and sample is used against the following element lines:

Element	Range Analyzed	Wave length of lines Element	Cobalt Reference
Fe	0.001–0.25	2600.7 Å	3412 Å
		3021	3512
		2963	3512
Pb	0.001–0.50	2833.1 Å	3512
		2873	3512
Cu	0.0005–0.01	2874	3512
		2824	3512
Ag	0.0008–0.01	3281.5 Å	3512
Al	0.001–0.05	3082.2 Å	3512
Sn	0.001–0.025	2840	3512
Ni	0.001–0.005	3414	3512
		3403	3512
Ba	0.02 –0.40	4131	4172
P	0.025–0.10	2536	3412

Standards for this method are prepared from fresh oil by adding quantities of known additives to cover the analytical range. The elements are added in the form of metallo-organics.

The standard deviation was determined on 20 successive determinations using the same sample. With 0.175% barium, standard deviation was 6.3%; with 0.04% phosphorus, standard deviation was 1.7%.



SAMPLE ELECTRODES are prepared with filter paper pallets.

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Special YESTERDAY	Standard TODAY

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You can easily select thermocouples from our many standard types—Wire or Tubular—Bayonet Immersion Contact—Exposed Loop—Protected—Straight or Angle. Available in all standard calibrations for Iron Constantan, Copper Constantan and Chromel Alumel. Many models are equipped with our Quick Coupling Plug or Jack Connectors or screw fastened connection heads.

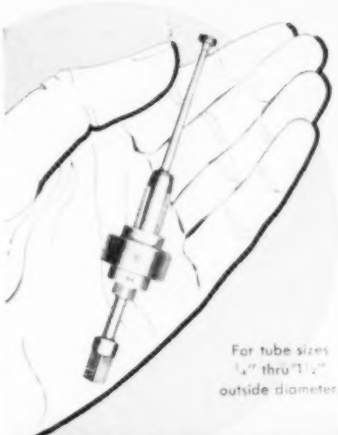
Write for Catalog I
Contains complete information on all our pyrometric equipment

Thermo Electric Co. Inc.
FAIR LAWN NEW JERSEY

IDEAL

They Said it couldn't be made— but here it is!

No. 255 Precision-Built Tube Expanders



For tube sizes ¼" thru 1½" outside diameter.

These precision Ideal Tube Expanders are unequaled for rolling tubes in Condensers, Coolers and other heat-transfer units. The Ball Bearing, adjustable thrust collar reduces friction to a minimum. You get every desirable feature—plus—in No. 255.

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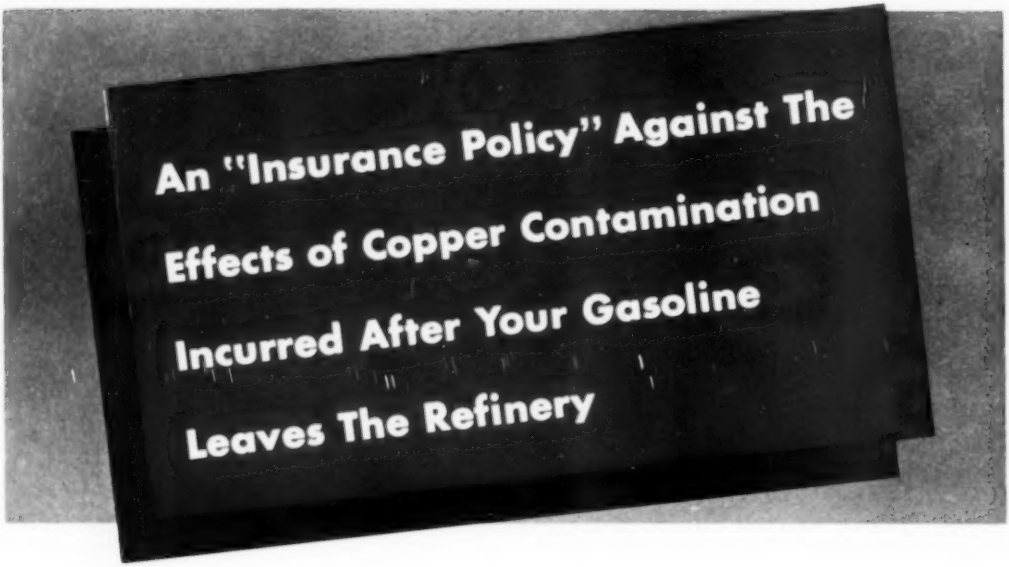

Assume your gasoline leaves the refinery entirely free of copper. Yet, it sometimes ends up at the service station or in a customer's car with traces of copper present. *How* can this be possible?

A careful examination of the distribution system generally uncovers the answer. All of these systems contain valves, pumps and various fittings which may be potential sources of copper contamination.

With consumer interest in gasoline quality running high, at-the-pump quality can be an important competitive factor. And for less than $2 per 1,000 barrels, you can *be sure* your gasoline is free from the effects of copper contamination . . . with Du Pont Metal Deactivator.

DU PONT METAL DEACTIVATOR is specially formulated to offset the harmful effects of copper in gasoline. And when copper is present—from any source—your desired stability can generally be obtained *more economically* with small amounts of Metal Deactivator than with antioxidants alone.

In typical gasolines stored at 110°F., for example, the period required to reach a 10 milligram residue level was only 6-8 weeks when antioxidants alone were used. But with the further addition of 1 lb. of Du Pont Metal Deactivator per 1,000 barrels, the stability period was increased to 28-34 weeks.

To determine the effectiveness of Metal Deactivator combined with Du Pont antioxidants in your own stocks, storage tests—rather than accelerated tests—are recommended. The nearest Du Pont district laboratory will be glad to cooperate with you. You can obtain samples of our products for your own evaluation by contacting your Du Pont Petroleum Chemicals Division representative.

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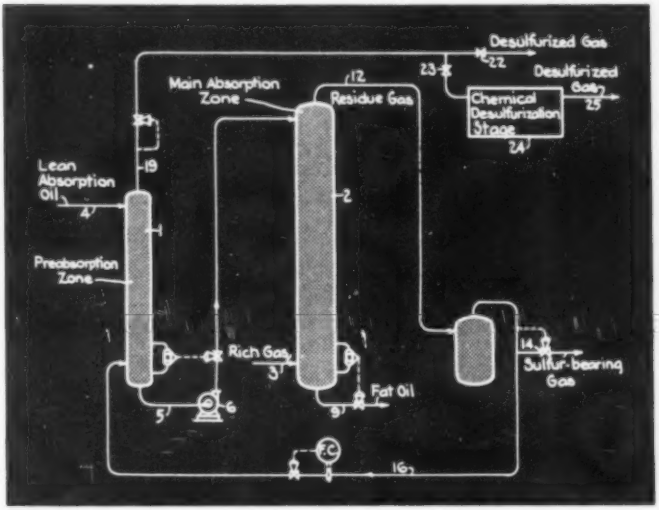
By Peter J. Gaylor, Patent Attorney, Gaylor, Cifelli & Jurick, Newark, N. J.



FLOW DIAGRAM of Shell Development's new process for sweetening a portion of residue hydrocarbon gases (U. S. 2,596,692)

Lean Absorption Oil Used to Sweeten Part of Residue Gas in Cycling Plant

IN U. S. patent 2,596,692, issued to Shell Development Co., a process is disclosed whereby a small portion of the residue gas discharged from the main absorption zone of a gasoline cycling or absorption plant can be advantageously desulfurized by contacting it in a preabsorption zone with a major portion of the lean absorption oil prior to the injection of such oil into the main absorption zone.

When such residue gas is treated for use as gas engine fuel, it is usually desirable to purify it to reduce its H_2S content to below 20 grains per 100 scf. When the residue gas contains of the order of 80 grains of H_2S per 100 scf, it is feasible to produce a purified gas containing less than 5 grains per 100 scf. In such cases, the need for a separate H_2S removal unit is entirely eliminated at a considerable saving in capital and operating costs.

The process employed is outlined by the flow sheet shown above. Here, towers 1 and 2 are absorption zones suitable for countercurrent contacting of liquid and vapor under pressure. A rich gas, such as that produced by a condensate well or a gaseous fraction from a crude oil well containing H_2S is fed through line 3 into the bottom portion of the main absorber 2. A lean absorption oil is injected under pressure through line 4 into the upper portion of the preabsorption zone 1 and withdrawn at the bottom by means of line 5 and booster pump 6. It is injected at the top of the main absorption zone 2 in which it absorbs constituents in the gasoline boiling range. The fat absorption oil is withdrawn at the bottom through line 9. From there it may be passed through the conventional flash drums and stripping units for the separation of the absorbed gasoline constituents from the absorption oil.

The unabsorbed gas (residue gas) is drawn off the top of zone 2 via line 12. Most of the H_2S and other volatile sulfur compounds introduced with the rich gas find their way into the residue gas. The bulk of this sulfur-bearing gas is withdrawn from the system through valve 14. A small portion of the residue gas (2-15%) is passed through line 16 and introduced into the bottom of the preabsorption zone 1, which is operated at a slightly lower pressure than the main absorption zone.

In the preabsorption zone a comparatively small volume of gas is scrubbed with the lean absorption oil, resulting in the absorption of H_2S together with some of the residue gas introduced. The scrubbed gas is withdrawn at the top through line 19. When operating on a rich gas feed having a relatively low sulfur content, the gas withdrawn from the top of zone 1 will usually be adequately desulfurized and may be withdrawn from the process through valve 22. But, if the rich gas has a high concentration of sulfur compounds, it may still be necessary to subject the gas to a chemical desulfurization step, such as the usual phosphate treater. In this case, valve 22 is closed and scrubbed gas instead passed through valve 23 into desulfurizer 24 and then withdrawn at 25.

Patents Issued in July

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for July 1, 8, 15, 22 and 29, 1952, Vol 660, Nos. 1-5.

PROCESSES

Catalysts

2,601,384 (Shell Development Co.) Apparatus for regenerating a fluidized catalyst.

2,601,228 (E. I. du Pont de Nemours & Co.) Process of redispersing a precipitated silica sol.

2,601,235 (Phillips Petroleum Co.) Reactivation of an alumina-metal oxide catalyst.

2,601,237 (Standard Oil Co. (Ind.)) Silica-magnesia catalyst for hydrocarbon-oil conversion.

2,601,238 (E. I. du Pont de Nemours and Co.) Molybdena amorphous titania catalysts.

2,601,239 (E. I. du Pont de Nemours and Co.) Coprecipitated silver beryllium oxide catalyst.

2,601,240 (E. I. du Pont de Nemours and Co.) Silver-beryllium oxide catalyst and method for making same.

Conversion

2,602,019 (William W. Odell) Fluidized process for promoting endothermic reactions at elevated temperatures.

2,602,771 (Standard Oil Development Co.) Process and apparatus for fluidized hydroforming of naphtha hydrocarbons.

2,602,772 (Universal Oil Products Co.) Conversion of hydrocarbons with platinum composite catalysts.

2,602,773 (Gulf Research & Development Co.) Catalytic destructive hydrogenation.

2,603,591 (Socony-Vacuum Oil Co.) Pulsating hydrocarbon conversion.

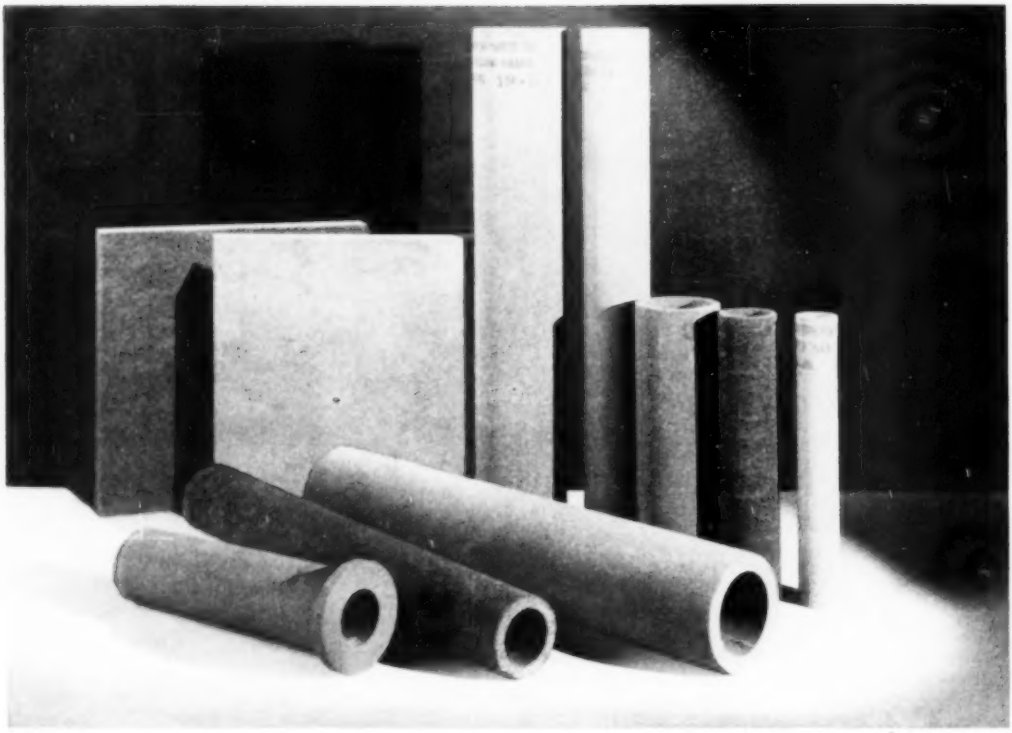
2,603,610 (Dow Chemical Co.) Preparation of a dehydrogenation catalyst using methyl cellulose.

2,603,626 (Standard Oil Development Co.) Low temperature polymerization process employing P_2O_5 treated alkyl halide catalyst solvent.

2,603,665 (Standard Oil Development Co.) Polymerization of ethylene in presence of aluminum chloride-methyl chloride solution.

2,604,438 (Shell Development Co.) Catalytic dehydrogenation of hydrocarbon oils after addition of sulfur.

2,604,465 (Standard Oil Development Co.)



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Hydrocarbon Synthesis

2,601,101 (Dry Manufacturing Co.) Apparatus for grinding wheat or other grains to meet variable demands.

2,602,020 (Gerber Corp.) Process for production of hydrogen and carbon dioxide.

2,602,506 (M. W. Kellogg Co.) Fluidized treatment of solid carbon containing materials to produce carbon monoxide for the synthesis of organic derivatives.

2,602,510-11 (Gulf Research & Development Co.) Process of synthesizing hydrocarbons using iron catalyst.

2,602,520 (Combustion Engineering-Superheater Inc.) Gas and steam generator for systems for obtaining fuel gases and other products from natural gas and the like.

2,602,606 (Standard Oil Development Co.) Contact method for reactions between hydrocarbons and metal oxides.

2,602,714 (Philips Petroleum Co.) Synthetic gas manufacture.

2,602,715 (The Texas Co.) Internal-combustion engine production of synthesis gas.

2,602,716 (Standard Oil Development Co.) Preparation of aqueous fuel oil and hydrogen.

2,602,717 (The Texas Co.) Conversion of heavy carbonaceous oils to motor fuels, fuel gas and synthesis gas.

2,602,724 (Philips Petroleum Co.) Regeneration of a carbonized Fischer-Tropsch catalyst.

2,602,725 (Standard Oil Development Co.) Catalytic conversion to CO and hydrogen.

Refining

2,601,903-4 (Gulf Water Control, Inc.) Method and apparatus for treating crude oil emulsions from oil wells.

2,602,044 (Standard Oil Co.-Ohio) Clay decolorizing of solvent refined lubricating oils.

2,602,051-60 (Petrolite Corporation, Ltd.) Process for breaking petroleum emulsions.

2,602,770 (Standard Oil Co.-Ind.) Process for desulfurizing hydrocarbons using a mixture of boron trifluoride and an alkane sulfonic acid as reagent.

2,602,306 (Chun Oil Co. of Calif.) Adsorption process and apparatus for C_4's gases.

2,602,310 (Philips Petroleum Co.) Method of and apparatus for separating the constituents of hydrocarbon gases.

2,602,311 (Floor Corp., Ltd.) Glycol dehydration of gases.

2,602,553 (Chun Oil Co. of Calif.) Adsorption process using moving bed.

2,602,567 (Philips Petroleum Co.) Propane fractionation of lubricating oil stocks.

2,602,569 (Shell Development Co.) Process for separating hydrocarbon waxes.

2,602,590 (Standard Oil Development Co.) Method of phenol extracting lubricating oil fractions containing naphthenic acids after adding KOH.

2,604,185 (Penn Anthony Equipment Co.) Method and apparatus for washing gases using Venturi nozzle.

2,604,430 (The Texas Co.) Continuous process for separation of waxlike constituents from oils using urea-type complexing agent.

2,604,434-5 (Atlantic Refining Co.) Solvent fractionation of wax-containing mixtures, using multiple additives.

2,604,436 (Anglo-Iranian Oil Co. Ltd.) Catalytic desulfurization of petroleum hydrocarbons with Co-Mo oxide Catalyst.

2,604,437 (Standard Oil Development Co.) Removal of sulfur compounds from hydrocarbon fractions after adding sulfur to NaOH extractant.

2,605,165 (Standard Oil Development Co.) Process for regeneration of spent doctor solutions with aromatic hydrocarbon.

2,605,171 (Chemical Construction Corp.) Apparatus for acid sludge decomposition.

2,605,231 (Standard Oil Co.-Ind.) Recovering ammonia trichloride from hydrocarbon extract phase.

2,605,232 (The Texas Co.) Process for removing phenols and mercaptans from light petroleum distillates using 4N caustic.

2,605,233 (Societe Anonyme Francaise pour la Separation l'Emulsion et le Melange) (Procedes R.E.M.) Methods for the acid refining of hydrocarbons using concentrated H_2SO_4 at high speeds.

2,605,234 (Tide Water Associated Oil Co.) Catalytic cracking of nitrogen containing oils by pretreatment with spent catalyst.

2,605,235-6 (Fabricia Corporation, Ltd.) Fine oil breaking petroleum emulsions.

2,605,237 (The Texas Co.) Separation of alkylbenzenesulfonic organic compounds from aqueous mixtures.

PRODUCTS

Chemicals

In 2,601,- (Shell Development Co.) Esters of unsaturated acid-branched chain hydrocarbon polymer products.

2,602,021 (M. W. Kellog Co.) Catalytic production of chlorine.

2,602,023 (Philips Petroleum Co.) Ammonium sulfate crystal manufacture.

2,602,800 (The Texas Co.) Tetrathioethers of pentaerythritol.

2,602,818 (Philips Petroleum Co.) Shortstopping emulsion polymerization of conjugated diolefin hydrocarbons with N-substituted dithiocarbamates.

2,602,819 (Philips Petroleum Co.) Separation of methyl ethyl sulfide from 6-hexene by distillation.

2,602,747 (Philips Petroleum Co.) Emulsion copolymerization of sulfur dioxide and unsaturated organic compounds with recovery of unpolymerized unreacted sulfur dioxide.

2,602,812 (Rohrchemie Aktiengesellschaft, Obermassfeld-Hedrin (Germany)) Process of oxidizing paraffinic hydrocarbons using nitrogen dioxide and concentrated nitric acid.

2,603,604 (Fluor Corp., Ltd.) Condensing lower C.H. hexanes of organic sulfur.

2,603,606 (Shell Development Co.) Stabilized aqueous solutions of surface-active sodium secondary alkyl sulfates.

2,603,629 (Universal Oil Products Co.) Inhydrocarbon peroxides capable of controlling polymerization reactions.

2,603,630 (Shell Development Co.) Production of peroxides.

2,603,650 (Universal Oil Products Co.) Preparation of heterocyclic compounds.

2,603,662 (Gulf Research & Development Co.) Process for producing sub-stituted hydroxy aromatic compounds.

2,603,664 (Socony-Vacuum Oil Co.) Reaction of olefins with $CF_2(OH)_2$.

2,603,667 (Philips Petroleum Co.) Fractional crystallization.

2,603,671 (Standard Oil Development Co.) Cellophane laminated with styrene-butadiene copolymer.

2,604,455 (Shell Development Co.) Azeotropic distillation of hydrocarbons.

2,604,480 (Standard Oil Development Co.) Devitalization of aqueous copolymers.

2,604,486 (Philips Petroleum Co.) Emulsion polymerization in the presence of a dialkoxy.

2,604,487 (Philips Petroleum Co.) Coagulation of synthetic latices and recovery of emulsifying agents therefrom.

2,604,459 (Standard Oil Development Co.) Selective oxidation of aromatics with suspended catalyst to produce phthalic anhydride.

2,604,496 (Shell Development Co.) Ether esters of glycerol.

2,604,491 (Standard Oil Development Co.) Iron removal from aldehyde synthesis process.

2,604,216 (Shell Development Co.) Process for separating the azeotropic mixture of allyl alcohol and allyl acetate.

2,604,242 (Standard Oil Development Co.) High solids content, low viscosity butadiene-styrene copolymer latex for emulsion paint base.

2,604,287 (Gulf Service Oil Co.) Hydrolysis of methylal.

2,604,290 (Standard Oil Development Co.) Process for the production and recovery of organic peroxides.

2,604,231 (California Research Corp.) Bis(hydroxyalkyl) peroxides.

2,604,293 (Shell Development Co.) Production of glycerine.

2,604,- (Shell Development Co.) Process for the preparation of acetylenic compounds.

Fuels

2,601,017 (Thompson Products, Inc.) Supplementary fuel emulsion containing soluble

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FOR REMOVAL OF BULK QUANTITIES OF WATER, SCALE, ROUGE AND AIR-
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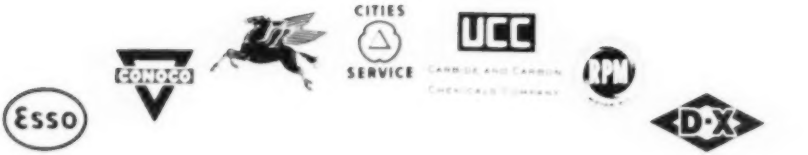

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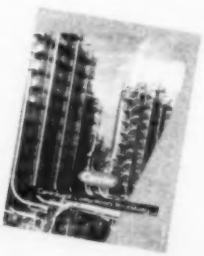

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(Oil corrosion inhibiting emulsifier.)

2,604,466 (U. S. Army) Compressed fuel units of dinitropropidene crystal.

2,604,537 (Theodore Magel) Method of effecting combustion of paraffinic hydrocarbon gases and vapors.

2,605,276-T (Allied Chemical & Dye Corp.) Manufacture of combustible gas.

Lubricants

2,602,045 (Standard Oil Development Co.) Maleate copolymer and detergent inhibitor lubricating oil additives.

2,602,049 (Gulf Oil Corp.) Phosphorus compound antioxidants for mineral oil lubricants and compositions containing the same.

2,603,599 (Gulf Research & Development Co.) Prevention of foaming of oils with polyhydric alcohol.

2,603,600 (Gulf Oil Corp.) P-S condensed addition agents and mineral oil lubricant compositions containing the same.

2,603,601 (Gulf Oil Corp.) Alkylated phenyl phosphite reacted addition agents and mineral oil lubricant compositions containing the same.

2,603,602 (Gulf Oil Corp.) Alkyl phosphite reacted addition agents and mineral oil lubricant compositions containing the same.

2,603,603 (Gulf Oil Corp.) P-S reaction products as improvement agents and mineral oil lubricant compositions containing the same.

2,603,604 (Shell Development Co.) Sulfide ester in methacrylate polymer lubricating composition.

2,603,627 (Standard Oil Development Co.) Lubricating oil additive materials prepared by condensing alkyl halides with halogenated-asphaltic hydrocarbon copolymers.

2,603,666 (Standard Oil Development Co.) Catalytic reaction of isobutane and propylene to produce lubricating oil.

2,604,449 (Swift Fitch Oil Corp.) Greases containing amic acid salts and compounds for making same and other compositions.

2,604,450 (Standard Oil Development Co.) Lubricating grease composition containing xyethetic ester.

2,604,451 (Gulf Research and Development Co.) Mineral oil compositions containing amide.

2,604,452 (Standard Oil Development Co.) Twister ring lubricant containing petrolatum and aryl amine phenol.

2,604,453 (Standard Oil Development Co.) Lauryl acrylate copolymer as V.I. improver in lube oils.

2,604,456 (General Electric Co.) Organo polysiloxane oils.

2,604,457 (General Electric Co.) Organosiloxane.

2,605,224 (Shell Development Co.) Metalworking lubricant containing lanolin, etc.

2,605,225 (Socony-Vacuum Oil Co.) Stabilized greases containing ion-exchange resin.

2,605,226 (Tide Water Associated Oil Co.) Compounded lubricating oil containing phosphate rust inhibitor.

Specialties

2,602,752 (William J. Francis) Skin tool antifouling paint containing paraffin wax and copper compounds.

2,602,779 (Cities Service Oil Co.) Method of inhibiting hydrogen sulfide corrosion of metals with diethyl thio urea.

2,602,780 (Ziemian, Wolfe, Baker & Spessard) Hydraulic fluid containing glycol and glycol ether.

2,602,571 (Union Oil Co. of California) Tall oil pitch and oxidized wax mastic floor covering and a process of making it.

2,603,574 (Shell Development Co.) Bituminous mixtures containing pozzolan and lime.

2,603,592 (Great Lakes Carbon Corp.) Pitch-like composition from coke and solvent.

2,605,191 (Standard Oil Co.) Asphalt composition containing sulfurized fatty acid.

EQUIPMENT

Processing, general

2,602,645 (Hydrocarbon Research, Inc.) Regenerator and piping therefor.

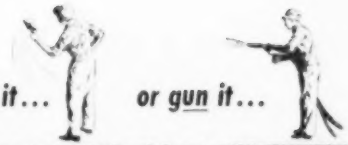
2,602,654 (Scientific Development Co.) Fractionation packing material.

2,602,662 (C. F. Braun & Co.) Bubble cap.

2,603,195 (Shell Development Co.) Tubular heater and method of controlling radiation effects therein.

2,603,306 (Phillips Petroleum Co.) Centrifugal apparatus for counter-current gas absorption.

2,603,308 (Union Oil Co. of Calif.) Absorption unit and process.



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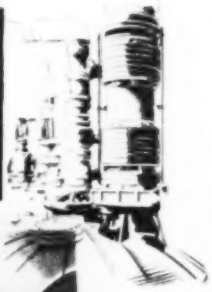

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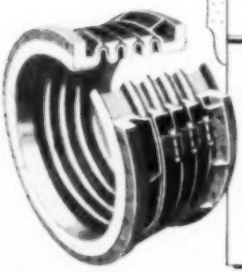

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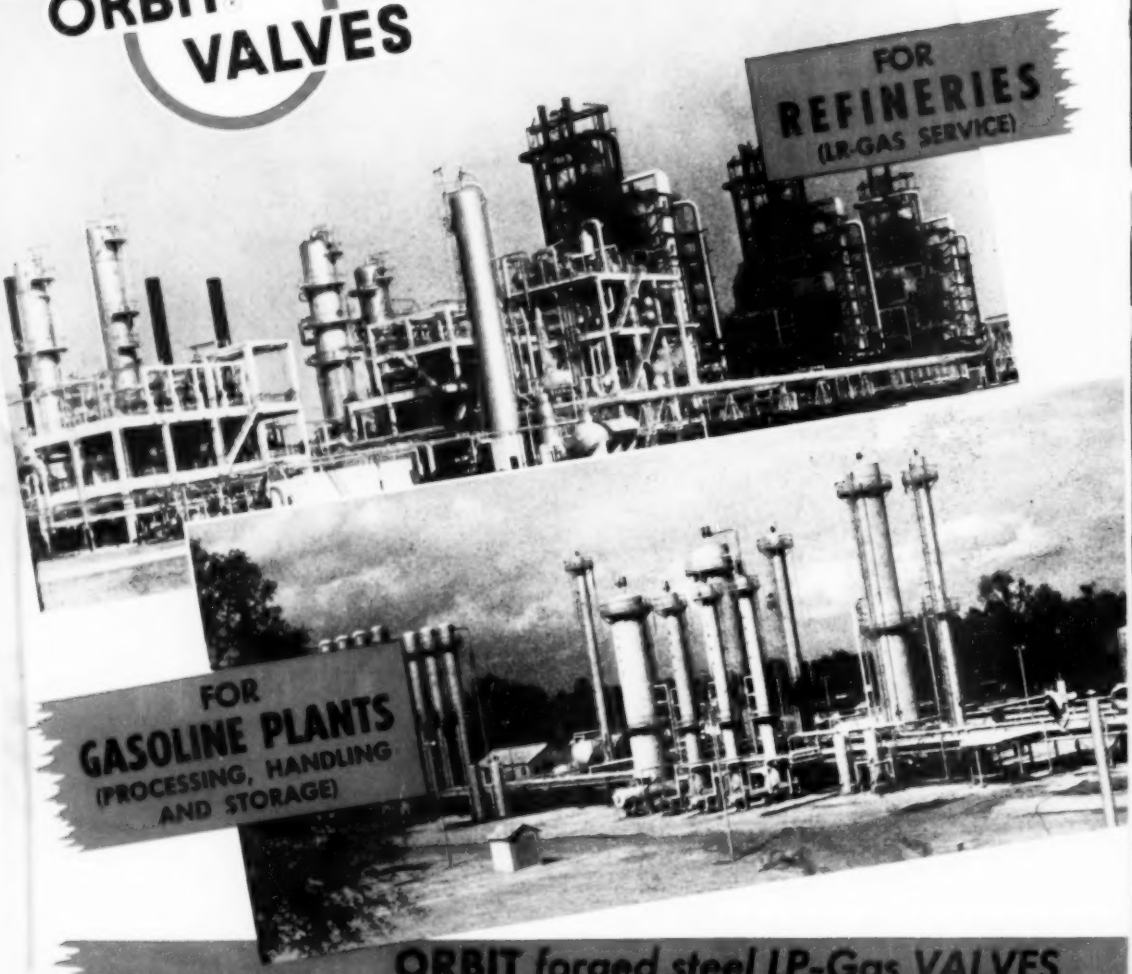

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GP's President Briefed By Carbide Men

R. L. Minckler (left), president of General Petroleum, hears about polyethylene, the "wonder plastic," from the men who will make it at Carbide and Carbon's new $36 million polyethylene plant in Torrance, Calif. GP will supply Carbide with refinery gases raw materials. With Mr. Minckler are three executives of Carbide and Carbon: (l. to r.) **R. N. Graham**, vice president in charge of manufacturing; **Dr. J. G. Davidson**, president; **L. J. Bowditch**, vice president in charge of engineering and construction; and (at extreme right) **Gale Adams**, GP's vice president in charge of manufacturing.

Sinclair Research Laboratories Inc. have made several top-flight personnel changes: **W. M. Flowers**, elevated from executive vice president to president of the company; **M. R. Fairlie** promoted to director of lubricants research; **C. J. Francisco** to the newly-created position of manager in charge of technical activities for Sinclair's Harvey research center; **W. R. Riggs** to the position of manager in charge of general services; **R. D. Pinkerton**, former director of light oils, to the new position, research associate; and **R. H. Gardner**, veteran of 33 years with Sinclair Oil Corp., to research associate. **A. H. Eron** has been appointed director of engineering. **Dr. K. A. Smith** has been promoted to director of the light oils division.

* * *

Personnel changes in the Bartlesville office of Phillips Chemical Co. effective last month include: **Edward Dolezal**, chief mechanical engineer, assigned to the newly-created position of chief project coordinator; **Austin Morgan**, assistant chief mechanical engineer, succeeded Mr. Dolezal as chief mechanical engineer; **T. M. Hipp**, recently on special assignment on an ammonia plant construction project near Houston, transferred to Bartlesville to fill the newly-created position of chief construction engineer.

* * *

Dr. H. A. Ambrose has been appointed director of the new Product Division of Gulf Research & Development Co. at Harmarville, Pa. **Dr. C. W. Montgomery** has been named director of the new Process Division with **W. C. Offutt** serving as assistant director. The Chemistry Division of the company was divided into these two divisions to provide greater efficiency and effectiveness in carrying out process and product phases of the company's research activities.

Dr. Ambrose received a B. S. in chemistry from Norwich University in 1924 and a Ph. D. in physical chemistry from Massachusetts Institute of Technology in 1930.

Dr. Montgomery was educated at Pennsylvania State College, receiving a B. S. in chemical engineering in 1930 and an M. S. in physical chemistry and mathematics in 1931. He received his Ph. D. in physical chemistry from the University of California in 1933, shortly thereafter joining Gulf's Chemistry Division.

* * *

Standard Oil Co. (Ind.) has made several appointments to section and group leaders in the research department at its Whiting, Ind., laboratory.

In the research divisions the appointments are **L. C. Brumstrum** to section leader and **H. J. Liehe** to group leader, greases; **A. W. Lindert**, section leader, and **R. S. Barnes**, group leader, industrial lubricants; **T. B. Tom**, section leader, and **R. A. Hunt**, group leader, light oils; **R. A. Dinerstein**, group leader, fractional distillation and hydrocarbon analysis; and **M. Den Herder**, group leader, catalyst research; and **J. W. Mohlman**, group leader, information services.

In the technical service divisions: **M. Gordon**, to section leader, light and heavy oils finishing and asphalt manufacture; **W. E. Stanley**, group leader, light oils finishing; **R. B. Selund**, section leader, distillation, coking, heavy oils processes, and acid manufacture; and **W. E. McGinnity**, group leader, heavy oils processes and acid manufacture; and **E. R. Walter**, section leader, and **G. M. Goodman**, group leader, economics.

* * *

Dr. Kenneth M. Watson has joined the Pure Oil Co., as director of research. He comes to the company from a consulting service he has operated for the past two years. He is to be located in Pure's research and development laboratories at Crystal Lake, Ill., where he succeeds the late **William B. Ross**.

Dr. Watson

Dr. Watson received his B.S. and M.S. from the University of Wisconsin, and then worked briefly with the Western Electric Co. as an assistant in engineering development. In 1926 he returned to the University of Wisconsin as a member of the chemical engineering staff. He also worked for his doctor's degree there and in 1929 received his Ph.D. in chemical engineering.

In 1931 he joined the staff of the Riverside Laboratories of Universal Oil Products and later was appointed director of engineering research. In 1941 he was a member of Gulf Oil Corp.'s engineering staff, and headed the technical committee for the

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2386

Neches Butane Products Co., Port Neches, Tex., a war project operated by five petroleum companies in the nation's synthetic rubber program.

Dr. Watson received the William H. Walker Award of the American Institute of Chemical Engineers in 1948 for "outstanding contributions to chemical engineering literature." He is the author of four chemical engineering texts.

He is a member of the American Chemical Society, the AIChE, the American Assn. for the Advancement of Science, the American Society for Engineering Education and the Wisconsin Academy of Arts, Sciences and Letters.

* * *

W. T. Askew has been appointed assistant manager of Sun Oil Co.'s Marcus Hook refinery, and has been succeeded as refinery superintendent by **John S. Thompson.** Mr. Thompson had been assistant superintendent in charge of the plant efficiency division.

Mr. Askew

Mr. Thompson

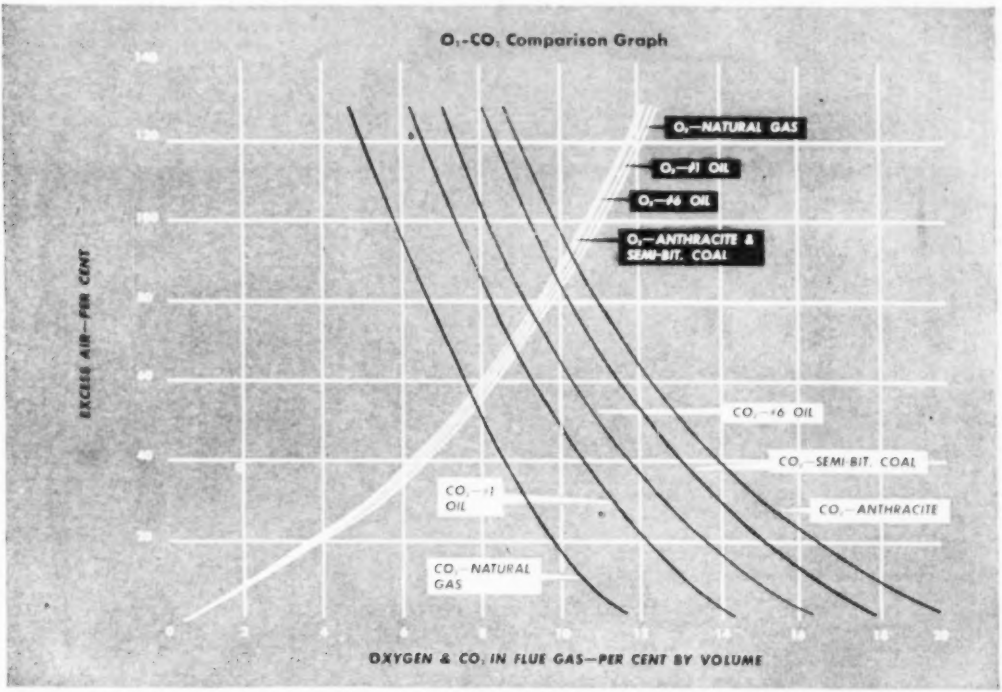
Mr. Askew joined Sun in 1931 upon graduation from Texas A. and M. College with a chemical engineering degree. He was in development work with the company until 1943, when he was named foreman of a large refining unit built for avgas manufacture. In 1944, Mr. Askew was appointed assistant superintendent in charge of gas recovery and alkylation. He continued in that capacity until his appointment as superintendent in May 1949. He is a member of the American Petroleum Institute and the Armed Forces Chemical Assn.

Mr. Thompson joined the company in 1931, starting as an engineer in thermal cracking plants at Marcus Hook. He later became superintendent in charge of cracking plants and in 1941 was named assistant superintendent in charge of plate efficiency. Before joining Sun, Mr. Thompson served as an engineer with The Texas Co. and E. I. du Pont de Nemours Co. He is an engineering graduate of the Princeton University class of 1927.

* * *

D. P. Stevenson has been named head of the chemical physics department at Shell Development Co.'s Emeryville, Calif., laboratories, replacing **Dr. J. N. Wilson.** Dr. Wilson has

How to burn Multiple Fuels efficiently



Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

When switching from one fuel to another or burning more than one fuel at the same time, you can realize large savings with a continuous indication of Oxygen content in your flue gas—because Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

This fact is borne out by the graph showing the relationship of excess air to CO_2 and O_2 in the flue gas of five common fuels. While the O_2 curves nearly coincide (especially in the important 50% excess air range) the CO_2 curves diverge widely.

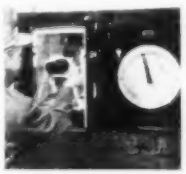
Large Savings Possible

This deviation was costing a medium sized refinery in Michigan $35-40 per day in boiler room fuel costs. Burning a combination of oil and gas they found that a combustion control system to handle their multiple fuel firing conditions would cost more than their small boilers.

They purchased a Hays Magno-Therm Oxygen Recorder, and immediately found that their boiler operation was so inefficient that the pen would not stay on the 0-10% chart. However, by operating with reference to the O_2 recorder they were able to reduce fuel costs enough *to pay for the instrument in 40 days.*

With the Hays Magno-Therm Oxygen Recorder you get:

Continuous, highly accurate indication and recording.
Complete compensation for temperature and pressure effects.
Freedom from chemicals or hazardous fuel burning in the analyzing process.
Swift, sure electronic operation.



If you are facing the problem of multiple fuel combustion, you will want a detailed copy of this O_2-CO_2 Comparison Graph as well as Hays Bulletin 50-329—describing the Magno-Therm Oxygen Recorder. Write for this free information.

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Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages
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National Foam engineers can survey your plant, study risks involved, and then determine the type of *foam protection* best suited to your plant's requirements . . . mechanical or chemical foams . . . the most complete choice of devices available . . . Foam Chambers for large tanks, Overhead Spray Deflectors, Nozzles, Dip Tank or Drainboard Systems, or even small extinguishers and other devices . . . whichever is best suited to your particular needs. Large plant, or small, National Foam specialists are ready to *engineer* foam protection to meet the hazards of your plant.

Let National Foam engineers and chemists show you how to get the best *foam* fire protection today! Consult your nearest National Foam Distributor, or write us direct about your problem.

NATIONAL
FOAM SYSTEM, INC.
Headquarters for Foam Fire Protection
WEST CHESTER, PENNA.

NATIONAL FOAM SYSTEM — CONTINUOUS PRODUCTION

Personals

been appointed head of the catalysis and surface chemistry department, replacing **M. W. Tamele.**

Dr. Tamele will concentrate his attention on his principal duties as associate director of research. He will continue to direct the general research activities of the chemical physics and catalysis and surface chemistry departments.

* * *

W. C. Stevenson has been elected vice president in charge of industrial relations for Union Oil Co. of Calif. He was formerly assistant to the executive vice president of industrial relations.

Mr. Stevenson

Mr. Stevenson joined Union Oil in 1925 as a utilities inspector at the Oleum refinery. He became foreman of the lube treating department in 1930, assistant superintendent of the refined oil division in 1931, assistant superintendent of lube oil operations in 1936, assistant superintendent of distillation in 1938, and superintendent in 1939. In 1940 he was transferred to the Los Angeles refinery in the same capacity and in March 1942 was promoted to refinery manager. He returned to the Oleum refinery as manager in December 1942. He received his appointment as assistant to the executive vice president in 1946.

* * *

Edward J. Grace, Jr., associated with Sun Oil Co. in instrumentation since 1933, has resigned from the company and is established as a process instrumentation and development consultant, with offices at 123 Princeton Ave., Swarthmore, Penna.

Educated at Purdue University, Mr. Grace was employed by Philadelphia Electric Co. and Brown Instrument Co. before joining Sun as instrument engineer at the Marcus Hook refinery. He became chief instrument engineer on Jan. 1, 1941, and in Sept., 1948, was assigned as instrumentation engineer to the Philadelphia engineering division, with the title of instrument consultant, which post he held at the time of his resignation.

He is an active member of the Instrument Society of America and the National Association of Corrosion Engineers.

* * *

Three chemical engineers with Standard Oil Development Co. have been promoted. **Harold A. Ricards** has been put in charge of the newly-formed petroleum cracking section of the process division. **Robert Hardy** has been named as his assistant. **John Weikart** succeeds Mr. Ricards as as-

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OXYGEN and NITROGEN *simultaneously*

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IF you now use both oxygen and nitrogen—or use one now and might need the other later—here's news that can save you thousands of dollars every year:

At slight extra cost, the larger models of *Air Products* High-Purity Generators can be converted to produce dry NITROGEN *simultaneously* with dry OXYGEN, both at purities to 99.9%!

You save up to 30% over any other method on your nitrogen requirements for annealing, steel making, heat treating, chemical manufacturing, packaging, etc. For higher purities—up to 99.99%—all you need is one piece of auxiliary equipment!

And You Still Get All the Savings of Making Your Own Oxygen...

. . . by eliminating transportation costs, handling costs, vaporizing costs, evaporation losses, residual losses, down-time due to delivery failures or shortages, etc. *Air Products* Generators take oxygen out of the *free* air, and deliver it *at any desired pressure*.

With an *Air Products* Generator, you know you are getting practical, proven equipment. Over 450 have already been put into successful operation. This experience has shown that oxygen-nitrogen generators must be simple, trouble-free and require very little maintenance. That's why *Air Products* standard Generators do not use complicated air-cleaning systems, and need *no* tricky oxygen compressors as necessary additional equipment.

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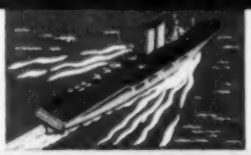
FIRST **Air Products was the first to make an oxygen generator that could be transported by truck.**



FIRST **Air Products was the first to make an oxygen generator that could be operated aboard ship.**

FIRST **Air Products invented the liquid pump for the delivery of high pressure oxygen and/or nitrogen.**

FIRST **An Air Products Generator was the first to be installed in a hospital for medical oxygen production.**

No more "*off the cuff*" decisions when you compare blower values

- ☐ Choice of Rotary or Centrifugal
- ☐ Capacity matched to the job
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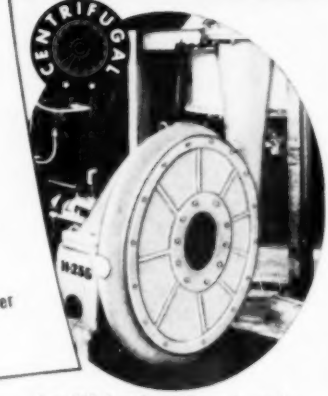

Type OIB Centrifugal Blower in use by southern petroleum company. Capacity 2,000 cfm. Motor driven through gear.

If you are considering new equipment for handling gas or air, we suggest you examine the essential values listed above, before you make your final selection. These factors will help you determine the unit that will best match your specific application, and that will give you the most satisfactory, economical performance.

You'll find that R-C equipment rates high in every one of these essential factors. With capacities ranging from 10 cfm to 100,000 cfm or higher, at moderate pressures, and with the exclusive *dual-ability* line of Centrifugal or Rotary Positive types, you have a wide choice to meet the most exacting needs.

If you'd like to tell us about your specific problem, we'll gladly send detailed information for comparison, or supply engineering help from our 93 years of blower building experience.

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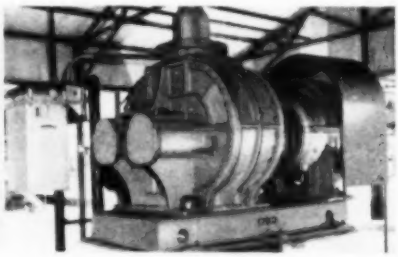
ROTARY

Type RCD Rotary Positive Blower for producing low-pressure air for asphalt oxidation still. Driven by squirrel-cage motor. Capacity 2,850 cfm.



ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC.

Personals

sistant head of the process division's white products and fuels section.

Mr. Ricards received his B.S. in chemical engineering from Johns Hopkins University and M.S. from Massachusetts Institute of Technology, whereupon he immediately joined the company in 1941.

Mr. Weikart took both his B.S. and M.S. from Cornell University. He has been with the company since 1942, active in research processes for the manufacture of high octane avgas.

Mr. Hardy, who joined the company in 1938, has been mainly concerned with research on the utilization of catalytic and thermal cracking processes. He received his bachelor's and master's degrees from Rhode Island State College.

* * *

Dr. John R. Bates has been appointed to the newly-created position of technical adviser to the executive committee of Sun Oil Co.'s board of directors. In order that Dr. Bates may give full time to his new duties, his administrative and operating responsibilities in charge of the chemical research and development department have been assigned to **Dr. J. Bennett Hill,** director of that department.

In his new position, Dr. Bates will conduct investigations of processes as they are developed in the future, and of markets and market trends for petrochemicals and petroleum products.

* * *

J. W. Smith has been promoted to superintendent of Continental Oil Co.'s refinery at Glenrock, Wyo. Mr. Smith, former assistant superintendent of Conoco's refinery at Denver, Colo., succeeds the late **Paul L. Rawdon.**

Conoco has appointed **R. W. Broadhurst,** former resident engineer at Ponca city, to succeed Mr. Smith as assistant superintendent in Denver.

* * *

D. L. Yabroff has rejoined Shell Development Co., Emeryville, Calif., as associate director of research, in charge of chemical products, replacing **K. R. Edlund,** who becomes special assistant to the president. Mr. Yabroff recently served as temporary manager of Shell Oil's manufacturing-research department in the New York head office.

* * *

Luther R. Hill has been appointed consultant on catalytic cracking and reforming operations for the Houdry Process Corp., Philadelphia. Mr. Hill is president of Process Designs Inc., a firm which he established this year at Ridgewood, N. J.

* * *

C. S. Huey has been named to handle process development and technical service for Salt Lake Refining Co., Salt Lake City.

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Yes, in all your heat transfer needs look for the big "W" . . . that brand means "quality" in telescopic exchangers, shell-and-tube exchangers, reboilers, floating head exchangers, and complete sections. Western Supply Company is geared to provide you with an engineering and fabrication service equal to any in the field. Consult with Western on ALL your heat transfer problems. Reports on their personnel and facilities are available upon your request.

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Tenamene

the most effective additives known . . . keep gasoline cleaner . . . longer . . . at low cost

WHAT IS GUM? Gum is a non-volatile material resembling varnish or lacquer. Soluble in gasoline, gum separates only when gasoline evaporates, unless highly concentrated. Sometimes gum settles as a heavy, dark-brown oil. The enemy of engine efficiency, gum coats carburetors, plugs jets and screens, and causes valves to stick.

WHAT INHIBITORS DO. Commercial gasoline inhibitors retard oxidative deterioration, the first step in gum formation. To prevent storage loss, inhibitors should be soluble in gasoline but not in water. They should not color gasoline and should resist darkening.

THE TENAMENES — EASTMAN INHIBITORS. For years Eastman has made the most effective gum inhibitors known—Tenamene 1 and Tenamene 2. Formerly these were sold through another company under another name. Now Eastman makes them available directly and from convenient stocks. Choice between the two gum inhibitors depends on a number of factors, such as the crude, the treatment and possible caustic carryover. Tenamene 2 should be used where traces of caustic are present. Where caustic is not present, choice must be based on such tests as ASTM Gum, Oxygen Bomb or Copper-dish Gum. Since Tenamene 2 is more concentrated and non-inflammable, its slightly higher cost is frequently more than offset by lower shipping costs.

FOR MOTOR FUELS. Tenamene 1 is a mobile, tan liquid composed of 48% N-n-butyl p-aminophenol in isopropanol. 5 to 52 lbs. per 1000 bbls. inhibit gum in most motor fuels, protect dyes from fading, and retard tetraethyl lead decomposition.

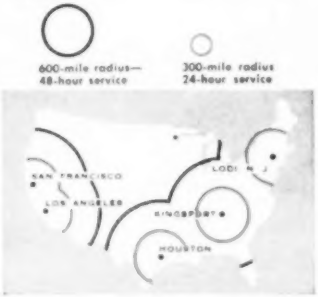
FOR MOTOR FUELS AND ALL AVIATION GASOLINES. Tenamene 2 is a mobile tan-to-red liquid comprising N,N'-di-sec-butyl p-phenylenediamine. For motor fuels generally, 2.6 to 26 lbs. per 1000 bbls. are used. Tenamene 2 has been thoroughly tested in aviation gasolines and approved for military purposes. It is highly resistant to extraction by water and caustic solutions. In hot, humid climates Tenamene 2 greatly retards deterioration of aviation gasoline that results in lead deposits. The maximum concentration allowable in aviation gasolines (8.4 lbs. per 1000 bbls.) should be added.

FOR COPPER CONTAMINATION. Tenamene 60, third member of the Tenamenes, is a mobile, red liquid composed of 80% disalicylal propylene di-imine in toluene. Traces of copper are often found in gasoline—from treating processes or from copper equipment employed during production, storage or use. Tenamene 60 overcomes the catalytic effect of copper on the oxidation stability of gasoline.

TESTS PROVE TENAMENE EFFECTIVE. Various tests with all types of gasoline proved the effectiveness of the Tenamenes. Uninhibited gasoline deteriorated rapidly in storage, forming considerable gum. Tenamene stabilized gasoline formed little gum in prolonged storage. Tennessee Eastman will be glad to make these analyses on any refiner's gasoline.

HOW TO USE TENAMENE. In general, unrefined cracked gasoline should be treated with Tenamene promptly after condensation. Refined gasoline should be treated as it is pumped to storage. If delay is necessary, add small amounts initially, the balance later. Tenamenes can be added in concentration, but are better added as dilute stock solutions since small quantities are generally involved. Common procedures are the proportioning pump, eductor or gas-pressure method. Tenamene 1 and 2 should be protected from air to prevent discoloration. Tenamene 60, however, does not need inert atmosphere for application.

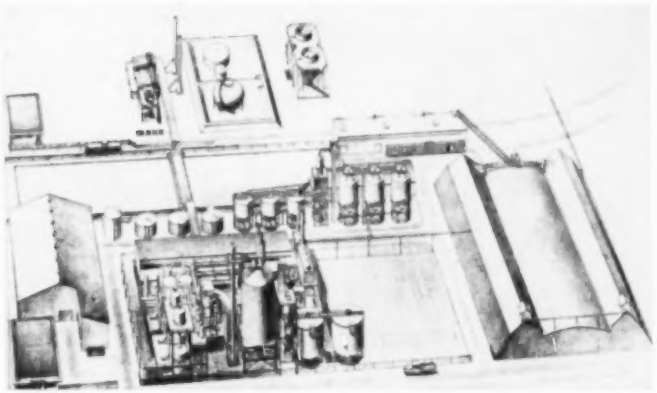
WHERE CAN YOU GET TENAMENE? Eastman can give top service on your requirements of these excellent additives. Stocks of Tenamene are carried at five convenient locations. A glance at the map below shows delivery schedules. Write to one of our sales representatives* or to Kingsport, Tennessee for prices, specifications, and other information.



Tenamene EASTMAN GASOLINE ADDITIVES

TENNESSEE EASTMAN COMPANY, *Division of Eastman Kodak Company, Kingsport, Tennessee*

***SALES REPRESENTATIVES:** New York—10 E. 40 St.; Cleveland—Terminal Tower Bldg.; Chicago—360 N. Michigan Ave.; Houston—412 Main St. **WEST COAST:** Wilson Meyer Co., San Francisco—333 Montgomery St.; Los Angeles—4800 District Blvd.; Portland—520 S. W. Sixth Ave.; Seattle—821 Second Ave.



Filtrol To Build Fertilizer Plant

LOOKING DOWN ON FILTROL CORP.'S PROJECTED $5 MILLION PLANT to be located at Vernon, Calif. Construction is to start in the immediate future. Filtrol plans to manufacture ammonium sulfate fertilizer and high purity alumina at the new plant. Shell Chemical Corp. will market the fertilizer output.

Garlock Names District Manager

Joe H. Dunlevy has been appointed district manager of Garlock Packing Co.'s Los Angeles office at 2303 East Eighth St. He succeeds Clarence W. Harmon, who has been district manager for the past 25 years. Mr. Harmon is retiring due to ill health.

Mr. Dunlevy

Mr. Dunlevy was a Garlock sales representative operating from the Cleveland office from 1919 to 1929. Then for two years he acted as a special representative for the vice president in charge of sales. He has served as a consultant on mechanical packing problems for the entire company since 1930 at Garlock's main office in Palmyra, N. Y.

TEMA Officers

Officers for the coming year in the Tubular Exchanger Manufacturers Assn. were recently elected at the association's annual meeting at Skytop Lodge, Skytop, Pa. Elected to head the organization were J. E. Hughes, president, and G. A. Worn, vice president. Mr. Hughes is director of the heat transfer division of the Western Supply Co. of Tulsa. Mr. Worn is manager of the heat exchanger department of Lummus Co. of New York. Reelected as secretary-treasurer was George P. Byrne, Jr., also of New York.

Speller Joins Counselors

Frank N. Speller, author and national authority on the subject of corrosion, has become an associate member of Management Counselors Inc., business consultants, 37 Wall St., New York. Dr. Speller has been actively engaged with industrial corrosion problems for more than 25 years, both in practical field operations and research.

Named Manufacturing Director

Ian K. MacGregor has been appointed director of manufacturing of the Consolidated Ashcroft Hancock Division of Manning, Maxwell & Moore Inc. Mr. MacGregor will be in charge of manufacturing at the Stratford, Conn., Watertown, Mass., Tulsa, Okla., and Jersey City, N. J., plants of the company.

A former vice president of Campbell, Wyant and Cannon in Muskegon, Mich., Mr. MacGregor was born in Scotland and graduated from the University of Glascow.

Fluor Board Adds Two

Two new members of the board of directors of Fluor Corp. are Franklin S. Wade, chairman of the board of directors of Southern California Gas Co., and Dudley E. Browne, comptroller of Lockhead Aircraft Corp. They have been elected to replace F. M. Stephens, vice president of Fluor's manufactured products division, and John F. Gardner, head of the project coordination board, both of whom have resigned.

New Engineering Firm Formed

Southern Refinery Engrg. Co. is a new firm with engineering, purchasing, and construction facilities, formed to serve the refinery and petrochemical industries in the Gulf Coast. It will make its headquarters in the M&M Bldg., Houston, and eventually will employ about 100 engineers and office personnel.

Mr. Schurman

President and General Manager of the new company is John H. Schurman, who is also president of Mechanical Construction Div., Huntington, W. Va. A mechanical engineering graduate of Marshall College, Mr. Schurman stated his company will design and construct complete refineries, gasoline plants, compressor and pumping stations, and petrochemical units.

Tom M. Lumly, with headquarters in Tulsa, is vice president. Mr. Lumly is also president of Refinery Engineering Co. of Tulsa, an affiliate of the new Southern Refinery Engrg. Co. L. E. Von Woglom is secretary, and was formerly chief engineer of Mechanical Construction Div.

The new Houston office will also serve as a Gulf coast office for Refinery Engrg. Co.

Foxboro Names Manager

John Deaderick has been appointed manager of the Foxboro Co.'s Philadelphia office at 1621 Chestnut St. The branch serves the industrial sections of eastern Pennsylvania and southern New Jersey. Previously serving as industrial engineer at Foxboro branches in Corpus Christi, Tex., and Baton Rouge, La., and as manager of the Tulsa, Okla., branch, Mr. Deaderick brings to his new assignment a thorough knowledge of modern instrumentation and its application to industrial processes.

Joseph Esherick, district representative of the Philadelphia branch for many years, now devotes his entire attention to Special Accounts.

Shamban Expands Plant

W. S. Shamban & Co. have expanded facilities for the production of molded and fabricated "Kelon-T" and "Kelon-F" fluoroplastic parts at their plant at 5747 Marilyn Ave.,

Stuck without WARNING

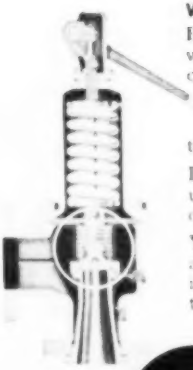
Who's stuck?

Safety valves that weren't safe? The plant which installed them?

None of this was necessary. If you want 100% safety—and you'd hardly want less—there's one sure way to get it—specify BalanSeal or FarriSeal Valves.

Why?

Because they *can't* stick, plug or corrode. Critical working parts are permanently isolated from any contact whatever with the lading.



Because they're unaffected by back pressures in the discharge manifold due to its own operation or to the opening of other valves in the line.

Because these features make it possible for you to use smaller discharge piping, an economy which is often substantially more than valve cost.

You'll be interested in the engineering of BalanSeal and FarriSeal Valves—design which is rapidly gaining acceptance in hundreds of successful installations.

Ask for our "8-Minute Brief."

Your Safety's REAL With FarriSeal

Farris ENGINEERING CORP.

438 COMMERCIAL AVE., PALISADES PARK, N. J.

Culver City, Calif. These products are stocked in rods, bars, sheets, tubes, cured and uncured tapes, and films in standard sizes. Also available is plastic coated glass cloth. The company coats metals and ceramics with the "Kelon" plastics.

Filtrol Names Purchasing Agent

R. S. Milton has been appointed purchasing agent of Filtrol Corp., to be responsible for purchasing practices and procedures for all Filtrol plants. He has been active in the company since 1937 when he was in charge of purchasing for California operations and sales department coordination.

Mr. Milton

Mr. Milton is a graduate of Harvard University. Prior to joining Filtrol he was with the American Potash and Chemical Corp., International Filter Co., and DeLaval Steam Turbine Co. in sales and purchasing work.

Heads A. O. Smith Distribution

J. H. Brinker has been appointed assistant executive in charge of distribution at A. O. Smith Corp. in Milwaukee. He moved into the new position from his former assignment of general sales manager for the Southwest district where he was headquartered in Houston.

Mr. Brinker

Aside from handling distribution of products, Mr. Brinker will provide general management service and direction to the manufacturing divisions in the distribution and marketing field. He is also to supervise advertising and sales promotion, exhibits and displays and market analysis.

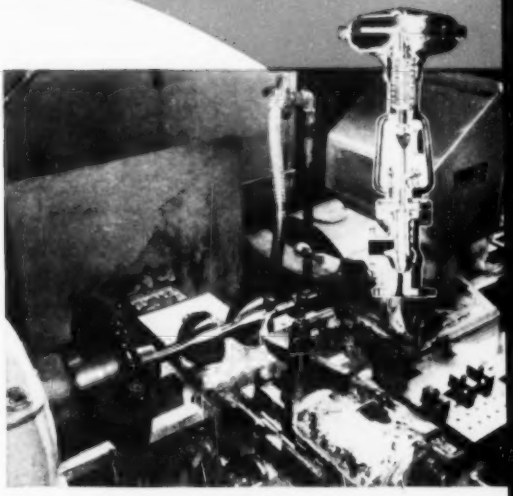
Mr. Brinker graduated from the University of Rochester in 1936. He worked for the Pfaudler Co. from 1937 until 1942. After four years service with the U. S. Navy he attended Harvard Business School where he was awarded a master's degree in business administration.

Foster Wheeler Names Lacock

A. J. Lacock has been appointed director of purchases of Foster Wheeler Corp. and will be responsible for the operations of the general purchasing department. He replaces E. J. Swenson who has been with

Close Tolerances at the BS&B Climax Controls Factory

1.



You demand controls designed and engineered by men thoroughly familiar with your industry. You demand the manufacturer be stingy with his tolerances . . . a stickler for exacting accuracy for you know that on such accuracy may depend your cost of operation—the safety of your equipment—the lives, even, of your people.

That's why we know we're being complimented when so many precision minded industries rely so completely on BS&B Climax Controls—they **trust** our knowledge and above all, our **care** in manufacture. BS&B Climax engineers protect this enviable reputation by constantly watchdogging the production of the Climax instrument that safeguards your control of pressures, temperatures, levels and flow.

And safety is not the only benefit Climax Controls may give you. Wide awake industries have found that Climax valves, controls, regulators or relays can in many cases . . . (a) eliminate manual operations, (b) vary, increase or multiply the functions of equipment, (c) supply additional safety factors, (d) reduce supervisory requirements.

2.

Generous Control Performance

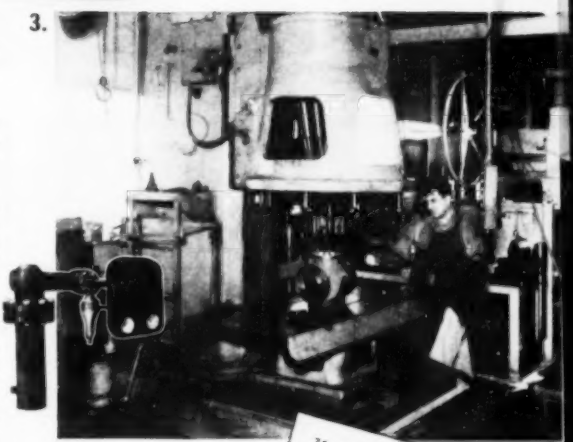
Performance and reliability show up in the manufacturing of Climax Controls. Here are a few of the steps that enable us to turn out over 12,000 different parts used in the assembly of various Climax Controls.

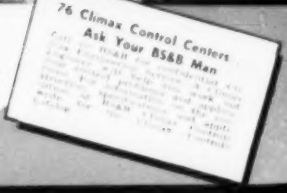
1 **"Peas-in-a-pod" Uniformity.** An electronic-hydraulic duplicator reproduces every inner valve from a template within .001" tolerance, assuring uniform inner valve characteristics.

2 **Part of the modern and orderly Climax Controls** factory . . . milling machines, deburring and grinding bench, drill presses and boring mill. Skilled and experienced operators contribute heavily to your control application where the name Climax appears.

3 **Applying Craftsman's touch to Mass Production.** For economy, which is passed along to you, Climax Controls are produced on an assembly line basis . . . for accuracy, which you enjoy in true performance, a Climax Control is never without the Craftsman's touch. Here a large multiple spindle drill works true bolt circles in a large body. A similar but smaller unit does the same job for smaller parts.

3.





EFFICIENCY BS&B RELIABILITY

BLACK, SIVALLS & BRYSON, INC.

Climax Controls Division 4-D 9
7500 East 12th Street Kansas City 3, Missouri

FACT

ABOUT TUBE PRICES

Alcoa Aluminum Heat Exchanger Tubes continue to have a significant price advantage over other metals. As this chart shows, Alcoa Aluminum Tubes cost ½ less than Admiralty, ⅓ less than Mild Steel, ⅕ as much as Stainless.

	PRICE PER 16 FOOT LONG TUBE			
	5/8" O.D. x .049" wall	3/4" O.D. x .049" wall	3/4" O.D. x .065" wall	1" O.D. x .065" wall
3S-H14	$1.12	$1.23	$1.55	$1.99
Alclad 3S-H14	1.42	1.64	1.95	2.55
Seamless Mild Steel	2.44	2.56	2.90	3.18
Admiralty Brass	2.96	3.39	4.46	5.85
Cupro Nickel (30%)	4.26	5.11	6.50	8.88
Stainless Steel (304)	9.09	10.02	11.41	13.72

NOTE: Prices for 3S-H14 and Alclad 3S-H14 based on lots of 2000—4999 lbs. For Admiralty and Cupro Nickel on lots of 10000 ft. with exception of size 1" O.D. x .065" wall which is based on 5000 ft.

ALCOA

knows most about their use and application

Alcoa pioneered the use of aluminum in heat exchanger tubes 45 years ago. For complete information on application and installation, write for a copy of the booklet, *Alcoa Aluminum Heat Exchanger Tubes*. Write:

ALUMINUM COMPANY OF AMERICA · **1863-J Gulf Building** · **Pittsburgh 19, Pa.**

OVER 6-MILLION FEET OF ALCOA TUBES ARE IN USE FOR APPLICATIONS LIKE THESE . . .

PETROLEUM

- Condensers handling hydrocarbon fractions from such processes as Thermal and Catalytic cracking, reforming, polymerizing, etc.
- Vapor recovery condensers
- Tube oil coolers
- Natural gas compressor after-coolers
- Recompressor after-coolers
- Hydrogen sulfide gas coolers
- Furfural condensers and heat exchangers
- Propane chilling
- Wax sweaters
- Lean oil—rich oil exchangers
- Amine solution coolers
- Glycol-amine heat exchangers and reboilers

CHEMICAL

- Butanol
- Ethanol
- Ethylene Glycol
- Glycerin
- Hydroabietyl
- Isopropanol
- Methanol
- Phenol
- Propylene Glycol
- Acetaldehyde
- Formaldehyde
- Furfural
- Heptaldehyde
- Acetic acid
- Stearic, Palmitic, Maleic, Oleic acids
- Butyric acid
- Naphtha
- Ricinoleic acid
- Acetanilide
- Ammonia
- Hydrogen Cyanide
- Nitric acid (concentrated)
- Pyridine
- Hydrogen Sulfide
- Benzene
- DicNlorobenzene
- Gelatin
- Hydrogen Peroxide
- Turpentine
- Xylene

Use Alcoa Alclad 3S-H14 Heat Exchanger Tubes with fresh, brackish and salt-cooling waters

the company since 1921 and will remain active as special assistant on purchasing problems.

Mr. Lacock, who is an industrial engineer, was previously employed by the General Electric Co. for 17 years. Since 1947 he was district manager of sales for the New York territory for Lukens Steel Corp.

Personnel Changes

Jefferson Chemical Co.—Dr. B. C. Rowley named market research manager. He received the appointment when market research activities on new products were recently transferred from the sales department to the technical and research department.

Monsanto Chemical Co.—J. Paul Ekberg appointed technical representative to the company's Washington, D. C., office. He was formerly assistant manager of petroleum chemical sales in the St. Louis office.

Universal Oil Products Co.—M. P. Venema, formerly a vice president has been elected executive vice president. M. D. Gilchrist, elected a vice president with responsibility for sales.

Worthington Corp.—W. A. Finn named assistant general sales manager. He has been in Paris, France, where he has been serving as general European manager, and will now make his new headquarters at the company's Harrison, N. J. offices.

Walter Kidde Constructors Inc.—Taylor Milton appointed vice president. He has been vice president and chief engineer of the company's Southwest subsidiary with headquarters in Houston.

Babcock & Wilcox Co.—William H. Old joins the company in the New York office as director of purchasing. He was formerly general purchasing agent with the American Brake Shoe Co.

Expansion, Transition

Technical Equipment Co., 1348 San Pablo Ave., Emeryville 8, Calif., has introduced an extensive line of petroleum products testing equipment, including that of Precision Scientific Co. and Braun-Knecht-Heimann Co.

Reflin Co., manufacturers of Fiberglas-reinforced tubing, have doubled production capacity by moving to a new plant at 16825 So. Broadway, P.O. Box 452, Gardena, Calif., from 8525 Higuera St., Culver City.

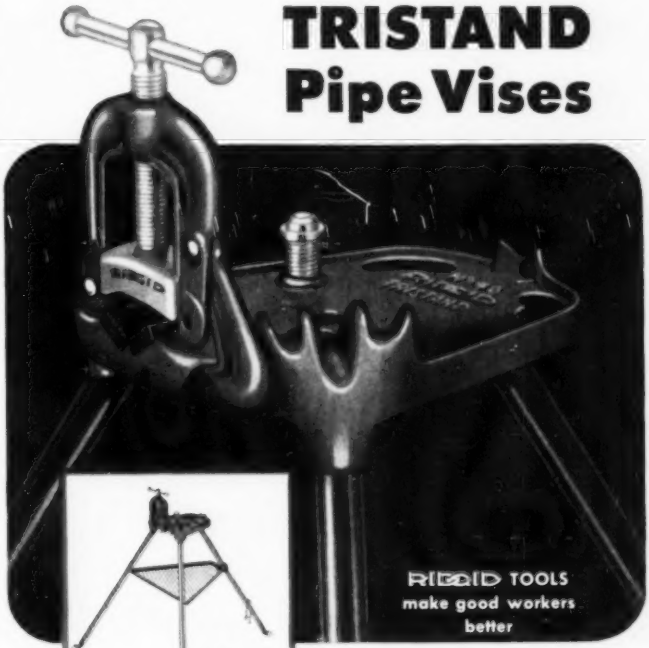
H. O. Trerice Co., manufacturers of temperature and pressure instruments, steam traps and air filters, have opened their fifteenth branch office. The office is located at 1304 Spring Garden St., Philadelphia, Pa.

Why Good Mechanics Demand

RIDGID

New No. 40

TRISTAND Pipe Vises



Handy tray keeps your tools at your fingertips

★ Tristand is really a portable workbench with a vise—roomy top tray has pipe benders and pipe rest; tool tray below keeps tools handy.

★ That tool tray also makes Tristand extra rigid — won't fold up in use.

★ LonGrip tool-steel vise jaws won't slip, are easy on polished pipe or tubing.

★ No. 40 yoke vise Tristand is 2½" capacity, No. 45 chain vise 4"—buy these work-saver RIDGIDs at your Supply House!

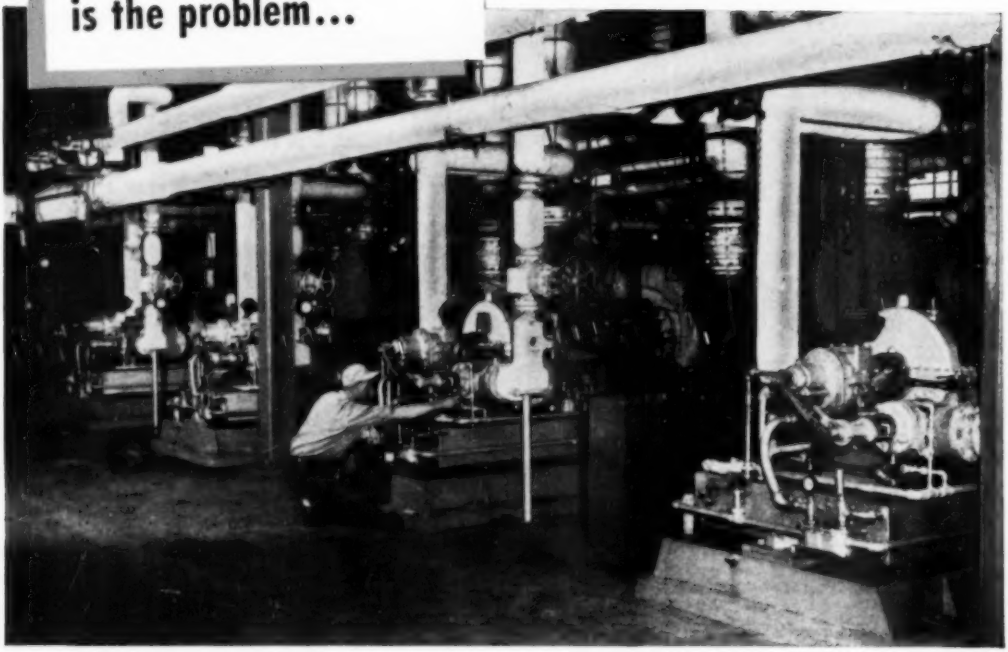
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RIDGID

Work-Saver Pipe Tools

(To obtain more data on advertised products see page 1344)

Where fluctuating load is the problem...



TYPE E gearturbines can handle it!

Process requirements in the evaporator room of the Masonite Plant, Ukiah, California, called for a variable-speed pump drive to provide for fluctuating load conditions. Steam was available. In the words of this user: "Westinghouse Type E, Close-coupled Gearturbines were selected since the pumps had to operate at relatively low speeds, and the higher efficiency inherent in the high-speed turbines was desirable. In operating performance, these turbines have proved the most efficient and economical solution to our problem."

Also in the evaporator room, the Masonite Company selected four Westinghouse Type E Turbines to drive the boiler feed pumps. These turbines provide an efficient, trouble-free drive which can be driven by the existing steam supply. Motor-driven units are used as stand-bys.

This use of both types of Westinghouse Turbines is the kind of over-all unit responsibility that actually makes your job of purchasing, installation, and maintenance easier . . . more dependable.

Wrapped up in a single package is a compact, rugged, and reliable speed-reduction unit solidly coupled to a Type E turbine. Each gearturbine is mounted on an extremely rugged base, fabricated of heavy steel plate which forms the oil reservoir. This arrangement simplifies mounting and installation. It provides operating stability never before available.

Get the full story on the broad Westinghouse turbine line. Book B-4346 clearly explains the applications, refinements and distinct standard features of Westinghouse Gearturbines. Call your nearby Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-50539

YOU CAN BE SURE...IF IT'S

Westinghouse

TYPE E Turbines

ASME Topics Include Insulation, Maintenance, Design, many others

FIFTEEN technical sessions and four inspection trips have been lined up for this year's American Society of Mechanical Engineers annual conference on petroleum mechanical engineering at the Hotel President, Kansas City, Mo., Sept. 22-24. The meeting is sponsored by the petroleum division of the ASME.

Starting the proceedings at 9:45 A.M. Monday, Sept. 22, is a session on "Refinery Design." P. E. Frank, engineer in charge of distribution terminals for the Sinclair Refining Co., is the presiding chairman. At 2:00 P.M., "Shale Oil Developments" will be discussed with chairman J. A. Markovits, assistant chief of the Bureau of Mines synthetic fuels demonstration plant, presiding.

Included in Tuesday's sessions is "Refinery Insulation," at 9:30 A.M. Presiding chairman will be J. P. Mooney, group supervisor, mechanical engineering and inspection division, Humble Oil and Refining Co.

Wednesday's schedule calls for sessions on "Design", "Materials", a "Refinery Maintenance Symposium", "Protective Treatment", and "National Gasoline and LPG Recovery and Storage."

The maintenance symposium will be presided over by chairman C. R. Draughon, assistant head, mechanical engineering department, Esso Standard Oil Co., and vice chairman A. A. Dahms, district manager, Allis-Chalmers Manufacturing Co. It is scheduled for 1:30 P.M.

Inspection trips are all scheduled for Tuesday, Sept. 23. Included are visits to Black, Sivalls & Bryson Co.'s plant, manufacturers of tanks, pressure vessels, valves, safety heads, dehydrators, etc., at 1:00 P.M., and an inspection trip to the Sugar Creek refinery of the Standard Oil Co. (Ind.) to see the new combination crude and coke unit, new research and engineering building, and the outdoor boiler plant, also at 1:30 P.M. A bus transportation ticket costs $1.00 for each of the inspection trips.

IOCA Papers To Cover Oil-Blending Techniques

THREE papers on oil compounding and blending will be presented at the Independent Oil Compounders Assn. fifth annual meeting to be held at the Edgewater Beach Hotel, Chicago, Ill., Sept. 25-26. F. L. Macwatty, vice president of the Cornell Machine Co., will deliver "Cornell Continuous Process for Proportioning and Homogenizing Lubricating Oil." R. R. Lowe, president of Proportioneers Inc., will discuss "Methods of Proportioning by Weight and by Volume." W. M. Harks, general sales manager, Bowser Inc., will present "Accuracy and Complete Homogenization in Continuous Process Blending." These papers will all be delivered on the morning of Sept. 25.

An inspection trip to the Cicero, Ill., compounding plant of the Cities Service Oil Co. has been scheduled for the morning of Sept. 26, followed by a visit to the research laboratories of the Sinclair Refining Co. in Harvey, Ill.

Petrochemical Topics On AIChE Program

PETROCHEMICALS will be the main theme of the one-day Oklahoma State Meeting of the AIChE which will be held in Tulsa on the campus of the University of Tulsa Oct. 11.

A program of 8 or 10 technical papers is being put together, including discussions of the following subjects: (1) production of nitrogen chemicals from natural gas, (2) shale oil refining, (3) production of ethylene, (4) low temperature gasoline plants, and (5) effect of economics on the utilization of LPG.

WPRA Fills Program With Refining Topics

AMONG the topics and features on the program of the Western Petroleum Refiners Assn. Technical-Industrial Relation meeting at the Hotel Henning in Casper, Wyo., Sept. 25-26 are:

1.) "Synthetic Fluid Cracking Catalysts: Their Applications and Utilization," a paper by R. B. Wainwright and C. O. Brown, American Cyanamid Co., New York;

2.) "Centralized Refining Instrumentation — Present Practice and Future Trends," a paper by R. A. Schlegel, Honeywell Regulator Co., Philadelphia;

3.) "Corrosion in Action," a sound

SHOP TIP

For an Easier Way to Remove Packing

Here is a rugged hand-tool that "works around corners" for removing old packing from stuffing boxes. The picture shows how a pair of these flexible handled tools operate around obstructions for snagging out those old packing rings. All steel—tempered tool steel corscrew bit.

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"International"

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FOR GASOLINE AND LUBRICATING OILS

"INTERNATIONAL" HEAVY DUTY, SIDE ENTERING MIXERS are designed for horizontal mounting below the liquid level in a tank. Particularly adapted to the blending of gasoline and other liquids in large batches.

REPACKED FROM OUTSIDE WITHOUT TANK LEAKAGE—These Mixers are of latest design. Equipped with a Ball Thrust Bearing to eliminate end-thrust on gears and motor. Send for Bulletin P-72 showing all Types of Mixers, Gearmotor and V-Belt Drive, in sizes from ½ to 30 H.P.

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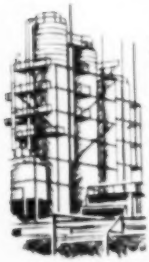
Why risk costly shutdown due to rusting through of insulation bands and wire. Specify ALMET 430 Stainless Steel Bands and Wire throughout your plant. Corrosion resistant to most acid and chemical fumes.



ALMET 430 strips available in .015" and .020" thicknesses and in widths from ⅜" to 1¼", or wire in .045" and .065" diameter. Other sizes available if required.

When drawing plans for a new plant or making repairs to existing insulations specify ALMET 430 for future assurance.

NO PRIORITY NEEDED! IMMEDIATE DELIVERY!

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ALLOY METAL WIRE CO., INC.
P. O. Box P-2, PROSPECT PARK, PA.

Meetings

film dealing with causes of various refinery corrosion problems, displayed by International Nickel Co. representatives.

11 Panel discussion on catalytic and thermal cracking. This discussion will be held Friday afternoon, Sept. 26, and the panel will be represented by both engineering and operations viewpoints. Moderator for the discussion will be C. E. Allison, Socony-Vacuum Oil Co. Inc., Casper refinery.

There is no registration fee required at the meeting and it is not limited to WPRA members.

Oil Man's Calendar

SEPTEMBER

American Chemical Society, 122nd national meeting, The Traymore Hotel, Atlantic City, N. J., Sept. 14-19.

American Society of Mechanical Engineers, Petroleum Div., annual conference on petroleum mechanical engineering, Hotel President, Kansas City, Mo., Sept. 22-24.

Western Petroleum Refiners Assn., 1952 regional meeting, Henning Hotel, Casper, Wyo., Sept. 25-26.

Independent Oil Compounders Assn., 5th annual meeting, Edgewater Beach Hotel, Chicago, Ill., Sept. 25-26.

OCTOBER

National Assn. of Corrosion Engineers, South Central Regional meeting, Jung Hotel, New Orleans, La., Oct. 1-3.

California Natural Gasoline Assn., annual meeting, Ambassador Hotel, Los Angeles, Calif., Oct. 8-10.

American Institute of Chemical Engineers, Oklahoma State Meeting, University of Tulsa, Tulsa, Okla., Oct. 11.

Industrial Packaging and Materials Handling Exposition, Chicago Coliseum, Chicago, Ill., Oct. 12.

Oil Progress Week, Sponsored by Oil Industry Information Committee of the American Petroleum Institute, Oct. 12-18.

American Institute of Electrical Engineers, Fall General Meeting, Jung Hotel, New Orleans, La., Oct. 13-17.

Scientific Apparatus Makers Assn., Recorder Controller Section, midyear meeting, Seaview Country Club, Absecon, N. J., Oct. 15-16.

Western Petroleum Refiners Assn., regional technical and industrial relations meeting, Oil Center Hotel, Wichita, Kan., Oct. 16-17.

American Society for Testing Materials, Committee D-15 on Engine Anti-Freezes, New York, N. Y., Oct. 16-17.

American Society for Metals, 34th Metal Exposition & General Congress, Convention Hall, Philadelphia, Pa., Oct. 18-24.

Independent Petroleum Assn. of America, annual meeting, Mayo Hotel, Tulsa, Okla., Oct. 20-21.

Packaging Institute, 14th annual forum, Hotel Commodore, New York, N. Y., Oct. 20-22.

National Safety Council, 40th National Safety Congress and Exposition, Conrad Hilton Hotel, Chicago, Ill., Oct. 20-24.

Natural Gasoline Assn. of America, regional meeting, The Blackstone Hotel, Tyler, Tex., Oct. 21.

National Lubricating Grease Institute, annual meeting, Edgewater Beach Hotel, Chicago, Ill., Oct. 27-29.

JAMES P. O'DONNELL
Engineers

PETROCHEMICAL PLANTS

DESIGN—PURCHASING
INSTRUMENTATION
CONSTRUCTION SUPERVISION

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SEE THIS NEW "Varec" FIG. NO. 2500 AUTOMATIC TANK GAUGE in action!

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CLEVELAND — SEPTEMBER 8-12
"VAREC" BOOTHS 402-4-6

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Company & Dept. _____
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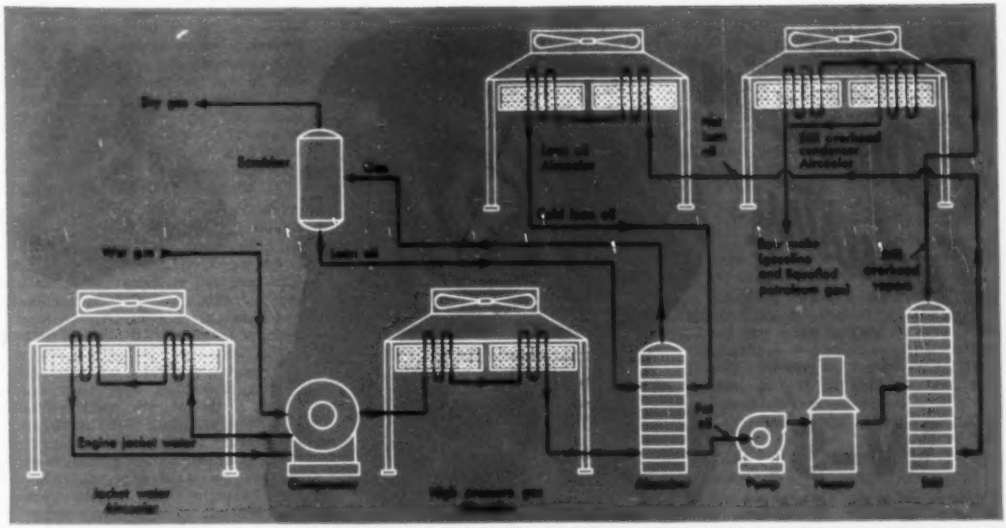
- cooling engine jacket water
- cooling high pressure gas
- condensing overhead vapors
- cooling lean oil



versatile ALCO AIRCOOLERS handle all these cooling duties at natural gasoline plants

ALCO

ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
Plants: Dunkirk, N. Y. • Beaumont, Texas

***In step with tomorrow*— ALCO AIRCOOLERS, Heat Exchangers, Evaporators, Feedwater Heaters, Pressure Vessels, Pipe**

ALCO Aircoolers demonstrate their versatility in natural gasoline plants. The simplified flow diagram above shows how Aircoolers are used to cool jacket water, cool high pressure gas, condense overhead vapors and cool lean oil.

The flexibility of ALCO fabricated steel header design also permits handling a number of different fluid streams in one tube bundle. For example, in some installations a single Aircooler may perform both the lean oil cooling and overhead vapor cooling functions.

ALCO Aircoolers are the logical and economical solution to all types of cooling problems where abundant good water is not available. Scale and corrosion troubles are eliminated.

For details call your nearest ALCO Sales Engineer at Beaumont, Chicago, Dunkirk, Houston, Los Angeles, New York or Tulsa.

Send Coupon for ALCO Aircooler Bulletin.

ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
Schenectady, N. Y.

Gentlemen:
Please send me the ALCO Aircooler Bulletin.

Name Position

Company

Address

City Zone State

(To obtain more data on advertised products see page 1344)

UNSURPASSED

in the Petroleum Industry

W-S FORGED STEEL FITTINGS

Screw-End and Socket-Weld Types

Since Watson-Stillman engineers first developed their special line of forged steel fittings to meet the service conditions of the Petroleum Industry, the W-S double-diamond trade-marked fitting has been identified with longer, more dependable life and lowest per-year cost in all phases of the industry's operations.

Precision-machined from solid drop-forged steel bodies, Watson-Stillman fittings are much less subject to unscheduled outages than fittings made from other materials or by other methods of fabrication. Being stronger, they are much smaller and lighter . . . bringing economies in weight and space all the way down the line. Their denser, tougher metallic structure is more resistant to corrosion, vibration, shock, and all types of stresses—including internal pressure and creep—than other types.

Yes, there are many reasons why W-S double-diamond fittings are preferred by *all* industries. Want more information? See your Watson-Stillman distributor or write direct.

• Stronger • Smaller • Lighter • Tighter
• More Uniform • Lower Service Cost

SOLD THROUGH LEADING DISTRIBUTORS . . . EVERYWHERE

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Designers and Manufacturers of Forged Steel Fittings, Hand Pumps, Jacks, Wire Rope Shears, Pipe Benders and Hydraulic Equipment

Heating Oil Stocks Higher than Year Ago in the East and Middle West

PLANT operations of the past few weeks leave no doubt as to the ability of refiners to make increased volumes of heating oils (kerosine and distillates). Indicated output of distillate fuels in August is about 20% greater than a year ago. The effect of the strike of refinery workers in May has been overcome and total stocks of heating oils Aug. 23 were higher than on Aug. 25, 1951.

The slow rate of movement of refiners' inventories of these products the past few weeks has focused attention on the volume of secondary stocks in the tanks of the local suppliers and distributing agencies. The larger oil companies in the east particularly would like to know whether the local suppliers are not taking material from refiners' storage because their own storage is full, or whether they are merely delaying completing their fillup for next winter's needs. The current situation is a good illustration of the need in the industry for statistical data on secondary stocks, as contrasted with primary inventories in the hands of refiners and in the large storage terminals.

In noting the gain in refiners' stocks of heating oils, Deputy PAD Warren in Washington said it was probably due to the fact that products are not moving at the normal rate from refineries and terminals into the tanks of secondary suppliers and consumers against the needs of the coming heating season. A PAD survey shows that refiners in the East Coast and Gulf Coast districts must step up their yields of the middle distillates by about 15,000 b/d avg. to avoid a deficit over the heating season of about 12,000,000 bbls.

Some oil companies, however, believe that secondary storage of heating oils is already at a high level. They point out that the local suppliers in general took material from refiners at a high rate in May and June this year, ahead of the price advance which came in July. In the past the trend has been for local suppliers to buy for fillup needs in the late summer. There has already been some liquidating of stocks by the local companies, to realize on the price advance, but it remains for the next few weeks to disclose how much of a factor this will be in later withdrawals from refiners' stocks.

The buildup in refiners' stocks of heating oils since June 1, when plant operations were full scale again after the strike, has been at the rate of about 5,000,000 bbls. a week, and during July and through most of August the rate of buildup was closer to 5,500,000 bbls. a week. As contrasted with the trend of stocks this year, in the 12-week period in 1951 from June 2-Aug. 25, the buildup rate was around 3,500,000 bbls. a week, and during July and August was around 2,700,000 bbls. The drawing on refiners stocks last year included material shipped abroad to make up for supplies lost when the Abadan refinery in Iran was closed. Table 1 shows heating oil stocks by PAD refining districts for Aug. 23 compared with Aug. 25, a year ago. The East Coast, Okla.-Kans.-Mo., and Calif. districts are well ahead of last year. The only large deficit is in the Gulf Coast district.

Indicated refinery output of distillate fuels in August is nearly 20% above the same month in 1951, and total output of distillates and kerosine is over 17% larger. For seven months, refinery output of kerosine was under that of last year and total output of heating oils only 3.8% larger. Indicated demand at refineries for heating oils in August is under that of a year ago.

The higher rate of output of motor fuel at refineries in relation to demand is reflected in smaller drafts on gasoline stocks. Motor fuel supply in July and August is indicated as around 7% greater than in the same months a year ago. Demand at refineries in the same months is around 3% greater. Indicated withdrawals of gasoline from refinery storage were only nominal for the first three weeks of August this year, as compared with drafts of over 3,500,000 bbls. in the same period in 1951.

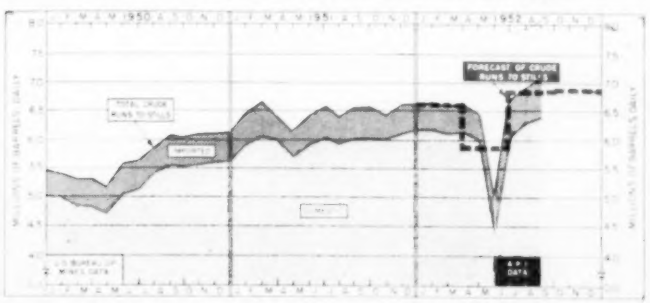
Table 1—Primary Storage of Heating Oils (Kerosine and Distillate) by Refining Districts

August 23, 1952 and August 25, 1951

	August 23, 1952	August 25, 1951*	Volume Change to 1952	% Change
East Coast	48,850	44,903	+ 4,208	+ 9.3
Gulf Coast	20,675	22,417	- 1,562	- 6.9
Total East Coast	69,934	68,830	+ 2,296	+ 3.4
Appalachian	2,855	2,917	- 62	- 2.1
Ind., Ill., Ky.	27,413	26,090	+ 1,323	+ 5.1
Okla., Kans., Mo.	13,870	11,771	+ 2,099	+ 17.8
Other Inland	6,661	6,460	+ 201	+ 3.1
Total East of Calif.	119,563	115,529	+ 4,837	+ 4.1
California	10,720	9,803	+ 917	+ 9.0
Total U. S.	130,283	125,559	+ 4,724	+ 3.1

* Revised figures.

Fig. 1—August Crude Runs at New High



Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
Aug. '52 API*	6,472	805	7,280
Aug. '51 BM	6,017	323	6,340
Change	+ 455	+ 482	+ 940
% Change	7.6	25.7	8.7

* Through Aug. 23.

Total (1000 bbls.)
(Bureau of Mines Data)

7 Mos. '52	1,260,287	110,264	1,370,551
7 Mos. '51	1,237,998	108,817	1,346,815
Change	+ 22,289	+ 1,447	+ 23,736
% Change	0.2	1.3	1.8

* July estimated from API data.

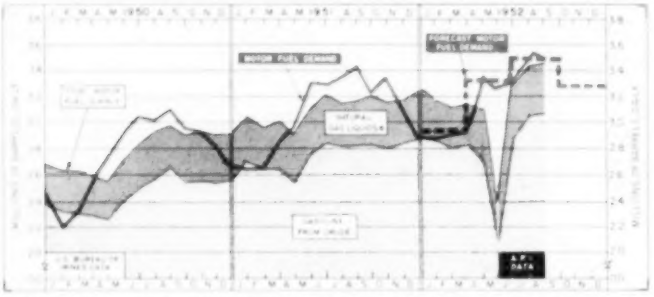
BM Forecast of Crude Runs to Stills
(July 28, 1952, b/d avg. by quarters)
Actual First Quarter; Estimated Second Quarter;
Forecast Third and Fourth Quarters
1st Q. 6,850; 2nd Q. 7,018; 3rd Q. 6,900; 4th Q. 6,950

Yields on Crude Runs to Stills

	Gasoline %	Kerosine %	Dist. Fuels %	Resid Fuels %
Aug. '52 API*	47.2	9.3	20.8	18.0
July '52 API	47.1	9.0	20.3	17.9
June '52 BM	47.5	8.7	21.3	18.0
Aug. '51 BM	45.5	7.2	18.8	18.2

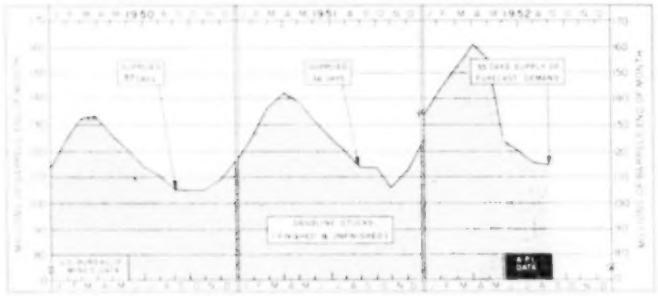
* Through Aug. 23.

Fig. 2—Refinery Gasoline Demand Slackens



*Natural Gas Liquids include gasoline blended at refineries, and that used as finished motor fuel.

Fig. 3—Little Change in Gasoline Stocks



*New basis for reporting added approximately 9,000,000 bbls. to primary stocks.

Fig. 4—Upward Trend in Heating Oil Output

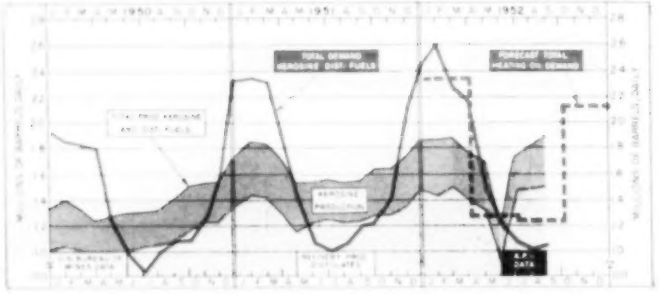
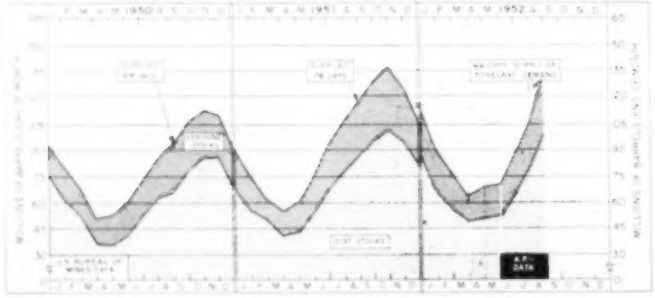


Fig. 5—Heating Oil Stocks Approach '51 Peak



*New basis for reporting added approximately 4,500,000 bbls. to primary stocks.

Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
Aug. '52 API*			
Aug. '51 BM			
Change			
% Change			
* Through Aug. 29			

Total (1000 bbls.)
(Bureau of Mines Data)

8 Mos. '52*			
8 Mos. '51			
Change			
% Change			

* July estimated from API data.

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

Aug. '52 API*	
Aug. '51 BM	
Change	
% Change	
* Through Aug. 29	

Total (1000 bbls.)
(Bureau of Mines Data)

8 Mos. '52*	
8 Mos. '51	
Change	
% Change	

* July estimated from API data.

BM Forecast of Motor Fuel Demand, 1952

(July 29, 1952, forecast as compared with actual and forecast figures of previous month)

Actual Third Quarter, Estimated Second Quarter, Forecast Third and Fourth Quarters.

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

Aug. '52 API*	
July '52 API	
June '52 BM	
Aug. '51 BM**	

* Dec. Aug. 29.
** Revised basis.

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
Aug. '52 API*			
Aug. '51 BM			
Change			
% Change			
* Through Aug. 29			

Total (1000 bbls.)
(Bureau of Mines Data)

8 Mos. '52*			
8 Mos. '51			
Change			
% Change			

* July estimated from API data.

Heating Oils Demand

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
Aug. '52 API*			
Aug. '51 BM			
Change			
% Change			
* Through Aug. 29			

Total (1000 bbls.)
(Bureau of Mines Data)

8 Mos. '52*			
8 Mos. '51			
Change			
% Change			

* July estimated from API data.

BM Forecast of Heating Oil Demand, 1952

(July 29, 1952, forecast as compared with actual and forecast figures of previous month)

Actual Third Quarter, Estimated Second Quarter, Forecast Third and Fourth Quarters.

Heating Oil Stocks

(1000 bbls. end of month)

	Kerosine	Dist. Fuels	TOTAL
Aug. '52 API*			
July '52 API			
June '52 BM			
Aug. '51 BM**			

* Dec. Aug. 29.
** Revised basis.

Fig. 6—Residual Fuel Imports Continue Low

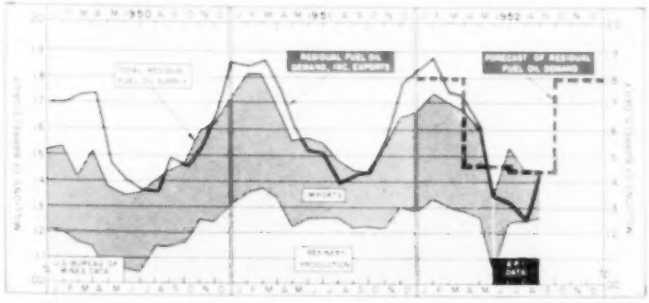
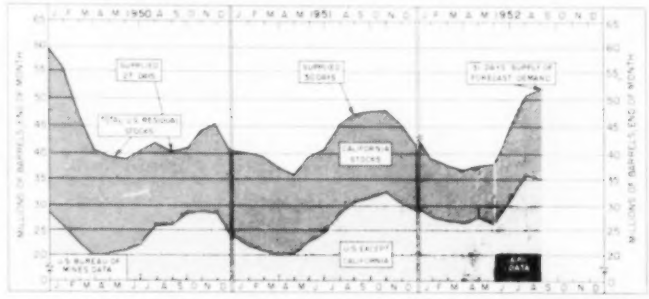


Fig. 7—Residual Stocks Hold Their High Level



*New basis for reporting added approximately 1,500,000 bbls. to primary stocks.

Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
Aug. '52 API*	1,470	201	1,671
Aug. '51 BM	1,220	247	1,467
Change	+250	-46	+204
% Change	+20.5	-18.6	+13.9
7 Months Aug. '52			
Total (1000 bbls.)			
(Bureau of Mines Data)			
7 Mos. '52	282,432	24,014	306,446
7 Mos. '51	258,156	32,300	290,456
Change	+24,276	-8,286	+15,990
% Change	+9.4	-25.6	+5.5

* Data estimated from API data.

Residual Fuels Demand

Daily Average (1000 bbls.)

Aug. '52 API*	1,440
Aug. '51 BM	1,416
Change	+24
% Change	+1.7
7 Months Aug. '52	
Total Demand (1000 bbls.)	
7 Mos. '52	318,818
7 Mos. '51	307,044
Change	+11,774
% Change	+3.8

* Data estimated from API data.

BM Forecast of Residual Fuel Oil Demand
(July 28, '52, Testimony Ex. 1647)
Annual Rate of Demand Needed Quarterly
Forecast Third and Fourth Quarters

3rd Q.	1,720,000 bbl./d	1,636,000 bbl./d	1,678
4th Q.	1,870,000 bbl./d	1,623,000 bbl./d	1,746

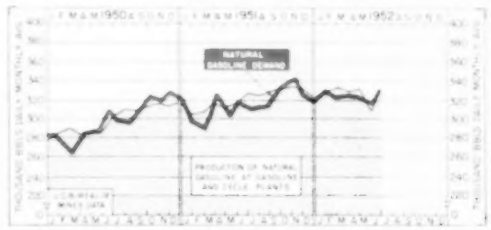
Residual Fuel Stocks

1000 bbls. end of month

	U.S. Except California	Total U.S.
Aug. '52 API*	52,910	52,744
July '52 API	51,240	51,142
Aug. '52 BM	52,241	51,904
Aug. '51 BM**	53,202	49,365

* 180 Aug. 25.
** Revised basis.

Fig. 8—Production and Demand of Natural Gas Liquids



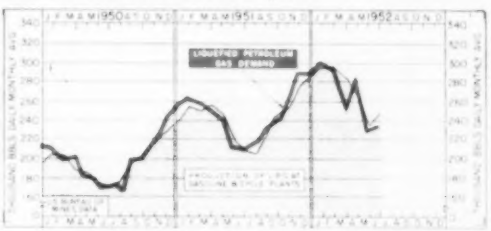
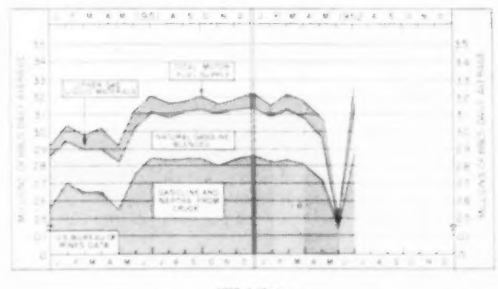


Fig. 9—Makeup of U.S. Motor Fuel Supply


TOTAL MOTOR FUEL SUPPLY
GASOLINE & NAPHTHA FROM CRUDE
NATURAL GASOLINE BLENDED
OTHER GAS LIQUID MATERIALS
U.S. BUREAU OF MINES DATA

1000 b/d avg.

Month	Gasoline & Naphtha from Crude	Natural Blended	Other Gas Liquid Materials	Total Motor Fuel Supply
July '52	2,668	291	190	3,149
May '52	2,707	301	190	3,198
April '52	2,732	304	190	3,226
June '51	2,561	268	190	3,019

Natural Gas Liquids Statistics

Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Products

Production (1000 gal. day avg.) Demand* (1000 gal. day avg.)

	Production Natural Gasoline	Production LPG	Production TOTAL	Demand Natural Gasoline	Demand LPG	Demand TOTAL
July '52	2,192	2,454	4,646	2,192	2,454	4,646
June '52	2,192	2,298	4,490	2,192	2,298	4,490
Change	+0	+156	+156	+0	+156	+156
% Change	+0.0	+6.8	+3.4	+0.0	+6.8	+3.4
7 Mos. '52	15,342	16,000	31,342	15,342	16,000	31,342
7 Mos. '51	15,342	15,000	30,342	15,342	15,000	30,342
Change	+2,192	+1,000	+1,000	+2,192	+1,000	+1,000
% Change	+14.3	+6.7	+3.3	+14.3	+6.7	+3.3

Total Production (1000 gal.) Total Demand (1000 gal.)

7 Mos. '52	15,342	16,000	31,342	15,342	16,000	31,342
7 Mos. '51	15,342	15,000	30,342	15,342	15,000	30,342
Change	+2,192	+1,000	+1,000	+2,192	+1,000	+1,000
% Change	+14.3	+6.7	+3.3	+14.3	+6.7	+3.3

Stocks End of Month (1000 Bbls.)

	By Type of Product				By Location		
(At gasoline plants and terminals only)							
Month	LPG	Natural Gasoline	Cond.	Finished Gasoline†	Gasoline Plants	Refineries	Total
July '52	2,991	2,191	1,012	6,192	6,192	3,991	10,183
May '52	2,996	2,191	1,012	6,199	6,199	3,996	10,195
April '52	3,115	2,191	1,012	6,318	6,318	4,115	10,433
March '52	2,179	2,191	1,012	6,382	6,382	4,179	10,561

* Production includes recoveries refinery as well as natural gasoline from natural gasoline and cycling plants. Receipts from refineries in June included 126,000 bbls. of natural gasoline and 108,000 bbls. of naphtha.
** Demand data are for total quantities shown produced for fuel and chemical purposes, which totaled 2,192,000 bbls. in June.
† Includes naphtha and other products.

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EQUAL WEIGHTS of the same material, aluminum silicate—as a solid (right), and as a fiber (left)

Ceramic Fibre Has Many Uses

"Fiberfrax" is a new development in a refractory or ceramic fiber—a vitreous aluminum silicate—presently available in a fluffy mass made up of random arrangements of extremely fine fibers, with an average thickness of 4 microns and length of three inches. A patented development by Carborundum, it can resist temperatures up to 2300° F. without loss of properties, and does not soften at temperatures approaching 3000° F.

Among its applications is that of a light weight, efficient furnace insulation. Two lbs. packed to a 6 lb./cu. ft. density fill the same volume as 14.6 lb. of high-grade refractory insulating brick and furnish the insulating efficiency of 20.9 lbs. of the same brick. Manufacturer states that possible savings make it directly competitive with the brick, even at its present pilot-plant price of $1/lb. It is made by melting aluminum oxide, silica, and modifying agents in an electric furnace and subjecting a molten stream of the material to an air blast.

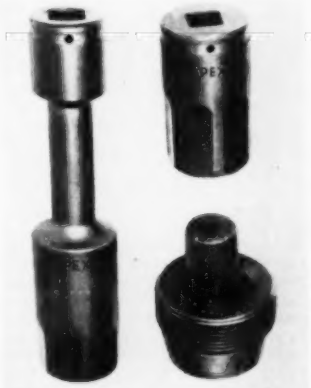
Possible applications, in addition to furnace insulation, include jet engine insulation, expansion joint packing, pipe insulation, electrical insulation strengthener, catalyst supports, gas or liquid filtration, etc. It is highly corrosion-resistant to most chemicals. The Carborundum Co., Niagara Falls, N. Y.

Circle No. **1** *on Reply Card*

Centrifugal Pump Will Handle Chemicals at up to 250 gpm.

A new chemical transfer pump, designated "Type CTB", is characterized by the use of a mechanical shaft seal in place of the usual stuffing box and by use of a stainless steel alloy for the wetted end. The pump is available for continuous or intermittent duty in transferring process chemicals, including acids, bases, salts, organic and inorganic solutions in all concentrations. Characteristics of the pump include horizontal end-suction, top discharge design, with a vertically split case. Built in four sizes, capacity range is from 10 to 250 gpm; head range is from 10 to 140 ft.; hp range is from 1 to 10. Temperatures of liquids handled can be up to 250° F. maximum. Materials of construction include cast iron frame and a liquid end of type No. 20 stainless steel alloy. This alloy has a chrome-nickel content of approximately 50%. Another design feature is the use of semi-open type impeller, with repelling vanes cast on the back of the impeller shroud. Repelling vanes assure the pump having maximum slurry and abrasive handling capabilities. No wear rings are necessary. A reduction of pressure on the shaft seal, providing optimum seal performance, is also obtained by this impeller design. Pumps are available from Indianapolis factory stocks. Peerless Pump Div., Food Machinery and Chemical Corp., 301 W. Ave. 26, Los Angeles 31, Calif.

Circle No. **2** *on Reply Card*



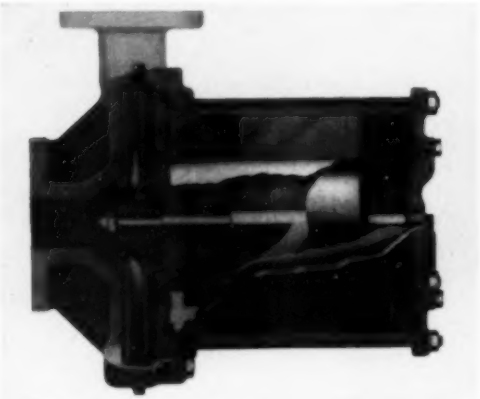
Square Drive Bull Nut Sockets Fit Cracker Pre-Heaters

A series of sockets designed for setting and removing bull nuts on preheaters of cracking unit furnaces are now being offered. These square drive sockets will fit any popular make of power tool and are available in a range of hex openings to accommodate all standard sizes of bull nuts. Although considerably lighter than the tools formerly used for this type of work, these bull nut sockets are said to provide longer service life and offer an economical solution to one of the most persistent of refinery maintenance problems. Apex Machine & Tool Co., 10 So. Patterson Blvd., Dayton 2, Ohio.

Circle No. **3** *on Reply Card*

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New." Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.



MOTOR STATOR IS ISOLATED from the pumped fluid by a stainless steel sleeve

SAFE, TOTALLY-ENCLOSED motor is kept cool by a recirculation system

New Centrifugal Pump Needs No Seals

"Chempump" is a new magnetically-driven, combined motor and centrifugal pump requiring no mechanical seals or stuffing boxes and designed to overcome many of the usual problems associated with the conventional centrifugal pump in handling corrosive or hazardous fluids. It is expected to find a wide variety of applications in petroleum and petrochemical processing. Sun Oil Co. is planning an installation on one new processing unit now under construction at Marcus Hook.

Essential features of the new pump are illustrated in the cutaway view. Fluid being pumped can come in contact with all parts except the motor stator. The stator is kept isolated by a non-corrosive, non-magnetic, and highly electrically-resistant, stainless steel cylinder or sleeve in the air gap space between stator and rotor. Other materials can be used where stainless is not satisfactory and the manufacturer is now studying such materials. To complete the stator assembly, it is encased in a heavy steel cylinder which acts as a frame for this portion of the motor. With cast end bells attached, the assembly is moisture and explosion-proof. The front end bell also serves as a mounting for the pump volute casting. Pump itself follows conventional design.

The standard isolating sleeve is designed for internal pressures to 150 psi but can be designed for higher operating pressures. It is pointed out that the pressure on this chamber is practically equivalent to suction and *not* discharge pressure.

The rotor portion of the motor is direct-connected to the pump impeller and rotates directly within the fluid being pumped. It can be sheathed also in a stainless steel "can" where desired. Bearings are U. S. Graphite No. 40, a molded composition of high hardness and wear properties found most satisfactory for the problems of no outside lubrication and resistance to fluids being handled. Thrust washers with grooved faces (for self-lubrication) provide adequate thrust areas so the pump can be operated in any position.

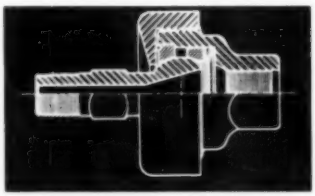
To overcome the problem of heat dissipation and avoid excessive motor temperatures, a circulation system carries a small amount of the pumped fluid from the high pressure side through the rotor chamber and returns it to the center of the impeller. This is standard on all pumps except those for handling slurries. In that case the base liquid of the slurry is fed into the rotor chamber at a low rate and is drawn into the eye of the impeller by the pumping action. For hazardous locations, such units have a flame trap between the rotor chamber and pump housing and the rotor chamber and the rear circulating line.

The Chempump is a one-piece unit which can be operated in any position. A separate base is not required but can be furnished on specification. Proper materials of construction can be furnished to meet nearly all corrosion problems.

The seal-less design is said to eliminate as much as 90% of all typical maintenance problems. Pump can be used under high vacuum conditions or on cycling pressure and vacuum conditions. It protects completely against release of dangerous fumes, valuable materials, or explosive and corrosive vapors.

Chempump Corp., 1300 East Mermaid Lane, Philadelphia 18, Penna.

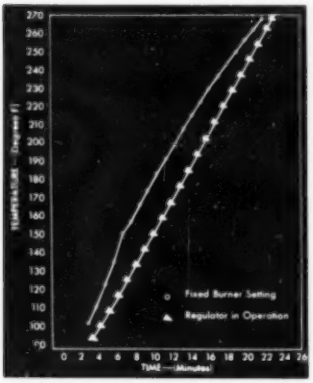
Circle No. 4 on Reply Card



Fireproof Ball Joints Work Under Extreme Pressures

Fireproof, all steel, flexible ball joints are now available in five sizes suitable for use on working pressures up to 7,500 psi. (hydraulic). They are furnished in 1, 2, 2½, 3 and 4-in. sizes. Produced in steel and alloy steel, the design differs somewhat from lower pressure joints in that the inner seal on the ball is a free-floating part carried under constant spring pressure. This insures positive, leakproof sealing at low or zero pressure and also makes the joint easy to turn and move. They have application in the chemical and high pressure steam power plant fields for service on steam up to 1,000° F. and 1,500 psi. Barco Mfg. Co., Dept. J-5, 1801 Winnemac Ave., Chicago 40, Ill.

Circle No. 5 on Reply Card



Automatic Regulator Simplifies Softening Point Determinations

Manual burner adjustments in the ASTM Ring and Ball softening point determinations can now be eliminated by using the "Fisher-Kermac Regulator." In this ASTM test the heat of a gas burner must be applied so that the temperature of the liquid bath is raised, but does not exceed 9° F. each minute. This means that the operator must be constantly vigilant and constantly adjusting. By using the new regulator, the operator has time to spare during the procedure. The burner was designed to supply the correct heating rate, as specified by ASTM, with only initial adjustment. (See chart for increasing temperature rates.) The regulator compensates for the increasing heat loss of the bath as higher temperatures are reached. The regulator adds the extra heat needed by automatically increasing the pressure of the gas (natural, artificial, or LP gases) entering the burner. This is accomplished by a synchronous, motor-operated pressure regulator. The proper setting can be readily determined by means of a manometer after the operator carries out a few practice tests. The regulator operates on 115-volt, 60 cycle A. C. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Circle No. **6** *on Reply Card*

Safety and Control Gained With New Flash Tester

An electrically-heated "Closed Cup Tester" has been developed for flash and fire point determinations of volatile, flammable liquids flashing below 175° F. in accordance with ASTM Method D-56. Advantages gained with the new device are: 1) greater accuracy of temperature control, 2) wide heater temperature range (from 100° to 700° F.), and 3) greater safety, since the only open flame present is that used to create the flash. It is essentially the same as the design specified by the American Society for Testing Materials, as well as by U. S. Government Master Specifications and the National Paint, Oil and Varnish Manufacturer's Ass'n. The hot plate is provided with a metal collar which supports a water bath in which the standard oil cup is suspended. The oil cup cover is equipped with the specified flashing mechanism and the flash burner has a gas tip which may be provided with an oil wick if desired. Pressing the handle on the cover mechanism automatically opens the port and introduces the flash flame into the oil cup. The tester is made of stainless steel and brass; hot plate and support collar are steel with heat-and corrosion-resistant baked enamel finish. A rubber-covered cord and plug are provided for connection to 115-volt, 50-60 cycle A. C. Overall dimensions are 8¾ in. high and 4¾ in. diameter; net weight is three lbs. Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Circle No. **7** *on Reply Card*

DID YOU MISS THESE?

The following items, reviewed originally in the July issue, have aroused considerable interest. They are repeated briefly as a service to those who might have missed them the first time. For details or literature, use the regular Reply Card in this issue.

Data on Chlorine Compounds

Organic Chlorine Compounds, Bulletin F-4769A; 28-page booklet gives uses, physical properties, specifications, and shipping data on commercially available organic chlorine compounds including mixed chlorinated solvents; including four pages of laboratory test methods such as specific gravity, acidity, freezing point, and chlorohydrin wt.-%. Carbide & Carbon Chemical Co., 30 East 42nd St., New York 17, N. Y.

Circle No. **8** *on Reply Card*

Manometers

Manual on Manometers, Bulletin 313; 12-page illustrated booklet on manometers includes basic facts and definitions on pressure measurement, how various types of manometers operate and what they measure, and details on installation, operation and maintenance. English and metric scales of equivalents are given for manometer readings taken with various indicating liquids, together with temperature correction factors and how to use them. King Engrg. Corp., Box 510, Ann Arbor, Mich.

Circle No. **9** *on Reply Card*

Ten Functions Can be Handled With Writing Slide Rule Device

A unique pencil device, the "Writing Slide Rule," has ten functions combined in one instrument. Included are a telescoping measuring scale, a reading magnifier, a depth gauge in inches and centimeters, a detachable straight edge, concealed eraser and spare pencil leads, a plain and enlarging indicator for the rule's A, B, C, D, L, S, T, CM, and IN scales, and an optical pocket-clip. Accuracy to the third significant figure is obtained in slide rule calculations. The device is 6½ in. long and weighs 0.8 oz. Device Development Co., 226 West Fourth St., New York 14, N. Y.

Circle No. **10** *on Reply Card*

Paint Withstands 1600° F. Heat And Bonds Metal Surfaces

"Super-Hot", a new ready-mixed aluminum paint, when applied to practically any metal surface, permanently bonds after subjecting it to heat from 500 to 1600°F. It will maintain its brilliance and will not crack, chip, or peel. It is said to make the painted object impervious to most ordinary solvents. This is due to the transition of the paint to an aluminum glaze that is an integral exterior of the painted object, according to the manufacturer. It can be brushed, sprayed, or dipped, and air dries within 30 minutes, after which heat can be applied. Sheffield Bronze Paint Corp., 17814 Waterloo Rd., Cleveland 19, Ohio.

Circle No. **11** *on Reply Card*

JOHNSON
Right Angle
GEAR DRIVE

Offers Wide and Varied Application in the Petroleum Industry

The Johnson Right Angle Gear Drive has a wide application in oil and gas industries. The drive is used by refineries for Cooling Tower installations with steam turbine, internal combustion, or electric prime movers. In the vicinity of natural gas pipe lines many gas engine gear drives are in use for farm irrigation and municipal water supply.

Vertical or horizontal prime movers can be used with equal success in many applications. The advanced design of the Johnson Drive meets the exacting requirements of exposed operation . . . assures maximum service and safety with utmost economy and dependability . . either for standby, emergency or continuous 24 hour service.

The Johnson Right Angle Gear Drive is manufactured in a wide range of types, sizes and ratios . . . adaptable for dual, multiple or combination operation. Thousands in use throughout the world serving industry at low operating cost and high efficiency. Catalog and full engineering data on request.

JOHNSON GEAR & MANUFACTURING CO.
8th & Parker Streets, Berkeley 10, Calif.
Please send Catalog and Engineering Data

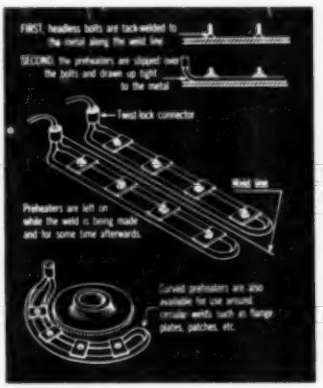
Firm .....
Individual .....
Street .....
City ..... State .....

What's New!

Tee Allows Heat Exchange Between Process Components

The "Swagelok Heat Exchanger Tee", available in brass, aluminum, steel, stainless steel and monel, is precision-made for numerous uses throughout laboratories and process industries. It has been designed for steam jacketing or temperature control of process lines. It is useful in all cases where it is necessary to effect heat exchange between coolants and process fluids. The small end of this fitting has been bored through the fitting to allow the tube to pass completely through the jacketed end. The Tee is available in sizes up to 1-in. O. D. for the jacketing tube. Crawford Fitting Co., 884 E. 140 St., Cleveland 10, Ohio.

Circle No. **12** *on Reply Card*


FIRST, headless bolts are tack-welded to the metal along the weld line
SECOND, the preheaters are slipped over the bolts and drawn up tight to the metal
Twist lock connector
Weld line
Preheaters are left on while the weld is being made and for some time afterwards.
Curved preheaters are also available for use around circular welds such as flange plates, patches, etc.

Welding Failures Reduced by Special Electric Heat Elements

An electric tubular heater design has been developed as a new aid in welding steel pipe and plate. It reduces the temperature differential between the weld area and adjacent metal, eliminating "locked-in" stresses that frequently cause failures in welded parts. (See drawing). In the case of straight line welds, heaters are held in place about six inches from the weld line by bolting to tack-welded studs. Special heater shapes can be attached similarly to various contours. Heater elements are triangular in cross section with one flat side on contact with the work. In operation, they are turned on before welding begins, until a temperature of 400-500° F. is attained in the weld zone and they are left on after welding is completed. These periods vary according to the type and thickness of the metal. Edwin L. Wiegand Co., 7605 Thomas Blvd., Pittsburgh 8, Penna.

Circle No. **13** *on Reply Card*

WEATHERCOAT is specified by leading refinery designs engineers.*

WEATHERCOAT is the standard for maintenance in leading refineries.*

Make these tests:

- Troweling Ease—Cold
- Flexibility with Toughness
- Freedom from Shrinkage
- Mixes with Sand for Scratch Coat (or buy ready-mixed MASTIC WEATHERCOAT)

Send for information. Prove to yourself that WEATHERCOAT gives the best yield and is the easiest to apply.

*Names on request.

AMERICAN Bitumuls & Asphalt COMPANY

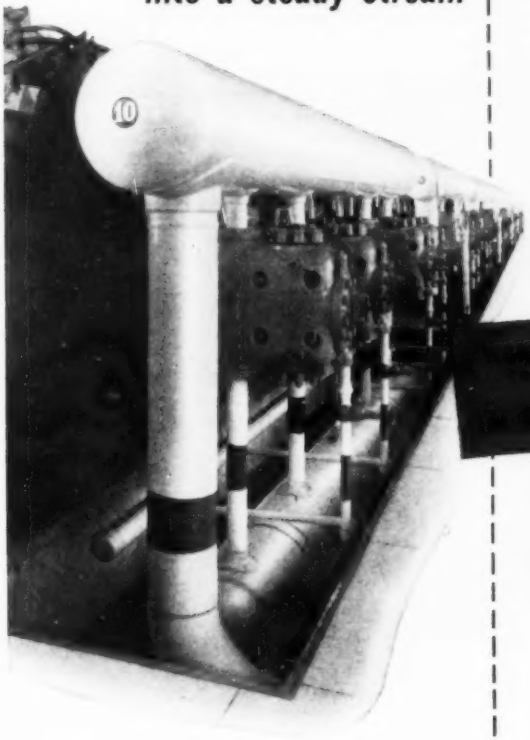
200 BUSH ST., SAN FRANCISCO 4, CALIF.

Providence 14, R. I. Perth Amboy, N. J.
Baltimore 3, Md. Columbus 15, Ohio Mobile, Ala.
Tucson, Ariz. Seattle, Wash. St. Louis 17, Mo.
Baton Rouge 2, La. Inglewood, Calif.
Oakland 1, Calif. Portland 7, Ore.
Washington 6, D. C. San Juan 23, P. R.

FLUOR

Pulsation Dampeners

convert a pulsating flow into a steady stream



How do you reduce the throbbing in your plant piping—with oversized piping and heavier wall thicknesses? With reinforced structure supports and mechanical vibration dampeners? How accurately are you metering gas?

Fluor Pulsation Dampeners work at the cause of the trouble. Their unique design principle smooths out pulsations to the extent of at least 85%. This means that damage to piping, coolers, heat exchangers, processing equipment and even buildings will be eliminated. It means reduced maintenance, more accurate gas metering and smoother, safer, more efficient plant operation.

Fluor Pulsation Dampeners are used on any type gas stream—air, steam, hydrocarbons—at operating pressures ranging from vacuum to 5,000 psi. Dimensions can be tailored to fit space limitations. Units may be installed on the suction and/or discharge lines and are sufficiently flexible to meet minimum pressure drop requirements.

guaranteed

Performance and workmanship are guaranteed in every instance where a Fundamental Pulsation Dampener or Pulsation Dampening System is installed. Here are excerpts from the guarantee:

"The Fluor Corporation, Ltd., guarantees that the pulsation dampeners or pulsation dampening systems . . . conform to all specific code requirements, and the workmanship is in accordance with standard shop practice by qualified welders."

". . . that the equipment will satisfactorily correct conditions of piping vibrations which are due to excessive pulse pressure in the piping system, or correct inaccurate gas metering caused by pulsative flow . . ."

". . . that the dampeners or pulsation dampening systems will decrease the magnitude of the pulse pressure in the compressor plant header piping to a value not to exceed 1.25 percent of the compressor operating pressure. The above percentage reduction applies to both suction and discharge pulsation dampeners or dampening systems . . ."

". . . that the pulse pressure in the plant header piping will not exceed the pulse pressure which is measured in the lateral between the volume bottle and the suction or discharge header, respectively."

". . . that the total pressure loss through the pulsation dampeners or pulsation dampening systems, measured by means of a differential pressure indicator and expressed in pounds per square inch, will not exceed the value set forth on the attached Dimensional Outline Sheet or layout drawing . . ."

Contact your nearest Fluor representative for the answer to your specific pulsative flow problems. Following preliminary study, he will be pleased to recommend the Fluor Pulsation Dampener that best fits your particular requirements. Or, write The Fluor Corporation, Ltd., Los Angeles 22, California.

Two Fluor "Package Type" Models

Fluor Pulsation Dampeners are available in two models: the Fundamental and the Higher Frequency. The Fundamental is recommended for installation in all compressor piping systems where excessive vibration is caused by peak pulse pressures at the fundamental frequency. The Higher Frequency Pulsation Dampener is recommended where frequencies are encountered above the fundamental (second harmonics or higher frequencies).

The Fluor Pulsation Dampening Piping System

Designed primarily for new construction, Fluor Pulsation Dampening Piping Systems are furnished in prefabricated form, ready for installation. Systems are designed for any type gaseous stream at operating pressures ranging from vacuum to 5,000 psi. Advantages include: improved flow measurement, fewer maintenance requirements, protection of related equipment, and smooth operation of plants and stations at rated capacity. Write for Bulletin PDS-8501.

FLUOR

Engineers - Constructors - Manufacturers

THE FLUOR CORPORATION, LTD. · LOS ANGELES · HOUSTON

New York, Chicago, Pittsburgh, Boston, Tulsa, San Francisco, Birmingham and Calgary

Represented in the Sterling areas by:
Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.1, England

DO MORE WITH FLUOR

The Petroleum Industry

STOPS RUST!

with

RUST-OLEUM

The Practical Way to Save Pipes, Tanks, Derricks, Buildings, Pumps, Roofs, Fences

Ask the maintenance men who battle rust daily! They'll tell you that RUST-OLEUM is the practical answer. (1) It may be applied directly over surfaces *already rusted* without removing all the rust. Wirebrushing and scraping with sharp scrapers to remove rust scale and loose particles is all that is usually required . . . eliminating costly sandblasting and chemical pre-cleaning . . . often enabling one man to do the work of two. (2) RUST-OLEUM *beautifies as it protects in all colors, aluminum, and white.* (3) RUST-OLEUM *stops rust* on every rustable metal surface indoors and out.

See how RUST-OLEUM can cut your maintenance costs. Prompt delivery from Industrial Distributor stocks in principal cities in the United States and Canada.

RUST-OLEUM CORPORATION
2480 Oakton Street • Evanston, Illinois

May be applied directly over rusted surfaces without removing all the rust!
Available in All Colors, Aluminum and White

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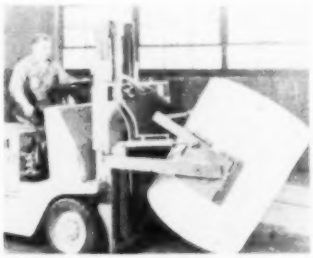
- ☐ Have a Qualified Representative Call
- ☐ Full Details on Free Survey
- ☐ Complete Literature
- ☐ Nearest RUST-OLEUM Source

What's New!



Fork Truck Attachment Allows Handling of Rolls or Drums

A quickly detachable roll clamp attachment for fork trucks has been designed to pick up and stack cylindrical objects either horizontally or vertically. The clamp allows operators to pick up and haul any cylindrical material from 1½-ft. to 3-ft. in diameter. It rotates 90° in a vertical plane so loads may be stacked either on sides or on ends. Clamping pressure is controlled by an adjustable relief valve in the hydraulic system, thus permitting operators to control clamping pressure for each type of material handled. The clamp is detachable in two minutes time. Two men can detach the clamp by removing retaining pins at the base of the truck carriage, detaching two push-pull couplings on the clamp's hydraulic line and lifting the clamp off the carriage. Then, a set of forks can be installed and locked by the retaining pins, and the truck is ready for pallet loads. The new attachment is available for any Baker fork truck from 1,000 to 4,000 lbs. capacity. Baker-Raulang Co., Baker Industrial Truck Div., 1230 West 80th St., Cleveland 2, Ohio.

Circle No. **14** *on Reply Card*

Scaler Useful for Lab Work In Radioactivity Studies

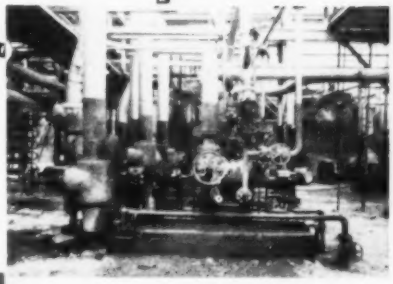
A simple, low cost, basic scaler has been developed for laboratories interested in entering the field of radioactivity. The "SC-19 Utility Scaler" incorporates an electronic scale of 256, a wide range preset count selection and a high voltage power supply for Geiger tubes. It uses eight

It's a Matter of Record

It's a Matter of Record
REFINING . . . NATURAL GASOLINE AND PETROCHEMICAL PLANTS OPERATE ON A 24-HOUR . . . SEVEN-DAY-A-WEEK BASIS. WHEN YOU NEED A PUMP FOR YOUR PLANT, YOU DON'T RUSH OUT WITH A WAD OF BILLS AND BUY A PUMP . . .
It's a Matter of Record
YOU SPECIFY Precision Built Pumps by PACIFIC PUMPS INC. because pumps for your exacting service are a considered purchase and
It's a Matter of Record
that customers say . . . "We believe Pacific is just about the finest group of pumps we know anything about."
It's a Matter of Record
That in the continuous process industries . . . shutdowns are costly . . . maintenance is a big problem . . . availability of parts and service facilities are important.
It's a Matter of Record
That customers say . . . "Pacific Pumps Inc. is large enough to stand behind the product they manufacture and small enough to give each order individual attention."

It's a Matter of Record

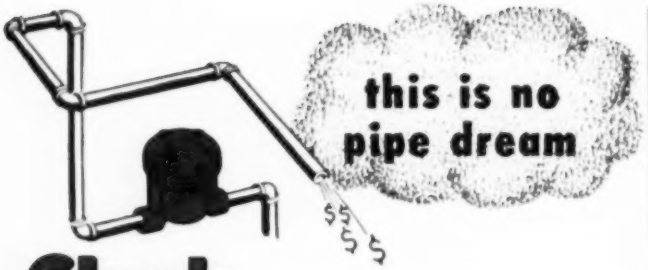
The excellent performance of the two stream turbine driven four stage pumps installed in 1939 to pump light hydrocarbons of .465 sp. gr. operating at 3400 R.P.M. In 1942 the speed was increased to 3900 R.P.M. From 1939 to 1950 time on stream 82 + % . . . pump parts refinished 0 . . . pump parts replaced 0. Third unit installed in 1947 to operate at 4000 4200 R.P.M.



PACIFIC *Precision Built* PUMPS

Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES
HUNTINGTON PARK, CALIFORNIA
Export Office: Chanin Bldg., 122 E. 42nd St., New York
Offices in All Principal Cities

(To obtain more data on advertised products see page 1344)



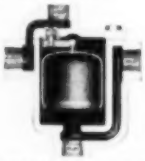
Clark CONTROLS
CAN SAVE YOU MONEY
All Down the Line!

If dollars are running through your steam lines it's time Clark Controls took over. Water in steam lines wastes fuel, cuts efficiency and adds greatly to maintenance costs.

Clark Steam Traps, with Duo-Stop Leverage, drain *twice* the condensate of ordinary traps. Clark Controls on your lines is truly like money in the bank. Write us for full details.

QUICK CLEANING STRAINERS

Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" P.S.I.



SERIES "70" Inverted Bucket Trap

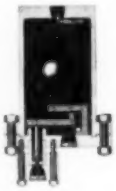
One of the most popular in the Clark line. Continuous flow capacities up to 2600 lbs. per hour. Sizes ½", ¾" and 1". Pressures up to 200 P.S.I.

SERIES "60" Inverted Bucket Trap

Choice of horizontal or vertical inlet or outlet. For pressures up to 150 P.S.I. "Clark-loy" guided disc and seat.

SERIES "450"

For continuous flow drainage. Pressures up to 600 P.S.I. Sizes ½" to 2". External discharge valve; "Clark-loy" disc and seat.



THE CLARK MANUFACTURING COMPANY
1830 East 38th St. • Cleveland 14, Ohio

Clark
THE HOME OF DUO STEP LEVERAGE

The complete line of dependable fluid controls

What's New!

electronic scales-of-two, giving a scaling factor of up to 256, followed by a mechanical register. A scale selector switch allows the choice of four scaling factors of 32, 64, 128 and 256. Total number of counts accumulated is obtained by multiplying the register reading by the selected scaling factor and adding the values of the neon interpolating lights. Predetermined counts ranging from 320 to 256,000 may be selected by means of a preset count switch which will stop the register at 10, 100, or 1,000. Special connectors make possible the use of a separate clock which is operated by the count-stop-reset switch or the use of a preset timer. The Utility Scaler has a resolving time of about 10 microseconds and a maximum counting rate of 1,000 cpm on the register. Counting rates up to 60,000 cpm result in less than 1% coincidence loss. High voltage power supply is regulated so that 1% change in line voltage causes only 0.1% change in high voltage. Tracerlab Inc., 130 High St., Boston, Mass.

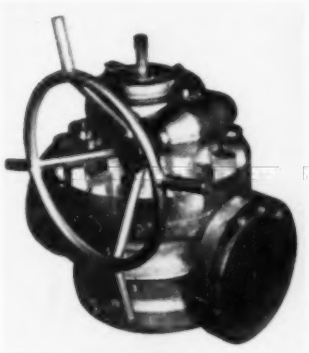
Circle No. **15** *on Reply Card*

Spray Fountain Protects Eyes, Nose and Mouth from Injury

An eye, nose, and mouth wash fountain has been designed, embodying new principles of spraying for thoroughly wetting the face in case of accident due to acid burn, dust, fumes, heat and contamination. The fountain helps to save eyesight or disfiguration by a gentle spray of a large volume of water. At what amounts to neutral pressure, the danger of back syphonage or cross-connection is eliminated. The fountain comprises a porcelain-enameled bowl with all piping and fittings of red brass, chromium plated. It is actuated by a non-leak, bat-wing valve. It comes in pedestal type, or for wall mounting. Logan Emergency Showers Inc., Box 111, Glendale, Calif.

Circle No. **16** *on Reply Card*

What's New!



Large Sized Plug Valves Now Use Enclosed Worm Gears

The use of "Cone-Drive" enveloping worm gearing on larger size lubricated plug valves is now feasible due to the high load carrying capacity and compact design of the gears. The gears are enclosed in a specially designed sealed housing that is filled with lubricant. Gears are standard on the ACF 400# Class, carbon steel valves with full round opening ports in size 4, 6, and 8-in. They are used on many types of larger valves in semi-steel and carbon steel where enclosed gearing is required or desirable due to weather or underground location. Larger size motor operated valves are equipped with these gears to insure trouble-free operation. American Car and Foundry Co. Valve Division, 1501 E. Ferry Ave., Detroit 11, Mich.

Circle No. **17** *on Reply Card*

Trade Literature

Cooling Tower Operation

Cooling Towers, Bulletin CT-52-4; 32-page booklet contains details of cooling towers with respect to fan drive, equipment support, floating shaft, speed reducer, water inlet, distribution system, fan, spray eliminators, casing, and inlet louvers, with suggestions on recirculation and surroundings; includes inquiry data sheet for users' planning requirements. Foster-Wheeler Corp., 165 Broadway, New York 6, N. Y.

Circle No. **18** *on Reply Card*

Protective Coatings

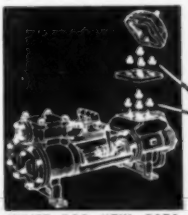
Insul-Mastic In Industry, Bulletin GM 101; 44-page booklet describes protective coatings, roofing and vaporseal insulated coatings, insulation cement, applications, physical properties, tests, and laboratory reports. Insul-Mastic Corp. of America, Oliver Bldg., Pittsburgh 22, Pa.

Circle No. **19** *on Reply Card*

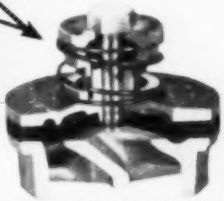
BETTER PUMP PERFORMANCE MEANS *Less Maintenance*

SIMS PUMP

Sims Pump Valves are guaranteed to give you better pump performance. And that means time, money and tempers saved.



1. Discs rotate for minimum wear while cushioned by liquid top and bottom. 2. Inclined ribbed seat and cushioned stem head combine to give smoother, faster valve action and take up shock.



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VALVE CO., INC.

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SOUTHERN REFINERY ENGINEERING COMPANY

TO PROVIDE ENGINEERING, DESIGN AND CONSTRUCTION FOR THE REFINING AND CHEMICAL INDUSTRIES OF THE GULF COAST AREA

JOHN H. SCHURMAN

President and General Manager

858A—M & M Building • Houston, Texas

8-hour job now takes 4 hours

At a western magnesium reduction plant something besides magnesium has just been reduced. The steam at the end of the 1½ mile long steam line wasn't so hot—and neither was the production record of the plant at that location.

Then 26 old-type steam traps were replaced with Yarway Impulse Traps. Now there is only a 15° temperature drop from the boilers to the end of the line. *Most important, the plant 1½ miles from the boilers is now able to do work in 4 hours that previously took 8 hours.*

That's trap efficiency! It's evidence of the fact that Yarways are designed to send the most premium B.T.U.'s at top temperatures into your process or product. *They get equipment hotter, sooner . . . and keep it hot.*

Other Yarway features—small size, one moving part, easy installation, low maintenance, low cost, stainless steel construction. Nearly 750,000 Yarways have already been installed. For your Yarways, see a nearby industrial distributor . . . 216 stock and sell Yarways.

YARNALL-WARING COMPANY, 153 Mermaid Ave., Philadelphia 18, Pa.

FREE TRAP SELECTOR

It's important to have the right trap in the right place. New 20-page selector tells quickly and easily which is the right Yarway trap for any application. Write for your free copy.

YARWAY

the steam trap

designed with more production in mind

What's New!

Data on Chlorine Trifluoride

Chlorine Trifluoride, Manual CT-1; 14-page booklet covering the properties and method of handling chlorine trifluoride, with first-aid treatments described for those who come in contact with the chemical; includes a drawing showing a laboratory still apparatus for withdrawing the chemical from cylinders. Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia 7, Pa.

Circle No. 20 on Reply Card

Boiler Tubes

B & W Electric-Resistance-Welded Steel Boiler Tubes, Bulletin TB-331A; four-page folder gives general information on welded boiler tubes, and contains tables of maximum allowable working pressures of electric-resistance-welded steel boiler tubes for fire-tube and water-tube boilers and weights per foot for various tubing sizes. Babcock & Wilcox Co., Tubular Products Div., 712 Eleventh St., Beaver Falls, Pa.

Circle No. 21 on Reply Card

Splashproof Motors

Elliott Induction Motor, Bulletin PB-7000-3; four-page folder describes a complete line of outdoor splashproof induction motors ranging in size from 250-4000 hp, 2 poles, 50-3000 hp, 4 to 14 poles; gives construction features, outdoor insulation, ventilation and maintenance features. Elliott Co., Ridgway Div., Ridgway, Pa.

Circle No. 22 on Reply Card

How to Enclose Heat

Heat Enclosure Methods; 50-page booklet, illustrated, dealing with the development of design and materials of fire vessels, showing how the principles learned have been applied to many types of units in many industries; and a description of a series of modern heat enclosure constructions applicable to today's units; includes an account of catalyst regenerators and oil heaters. M. H. Detrick Co., 111 W. Washington St., Chicago 2, Ill.

Circle No. 23 on Reply Card

Stearate Specifications

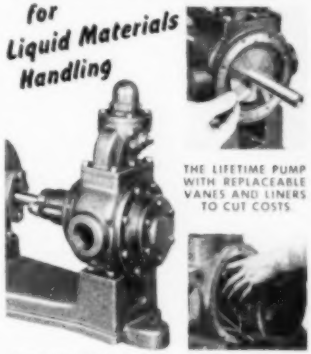
Cyanamid Metallic Stearates, Leaflet 700; eight pages of revised specifications on aluminum, calcium, magnesium, zinc, and lead stearates; brief description of stearate uses included. American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.

Circle No. 24 on Reply Card

Electronic Level Gage

Electronic Remote Reading Liquid Level Gauging Equipment, Bulletin CP 3001; four-page folder gives construction and circuit features of gager receiver units, series transmitters, and automatic tank gage; in-

BLACKMER
Self-Adjusting for Wear
ROTARY PUMPS
for Liquid Materials Handling



THE LIFETIME PUMP WITH REPLACEABLE VANES AND LINERS TO CUT COSTS

10 TO 1500 GPM

Get FACTS About Petro-chemical Rotary Pumps . . .

See why Blackmer Pumps are preferred for liquids from ether to asphalt.

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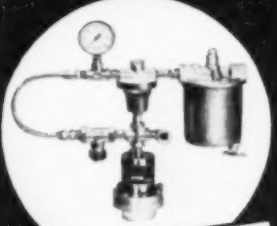

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Ideal for measurement of level, pressure, specific gravity and differential pressure.

Materials available: steel, bronze, stainless, Haveg, Hastelloy and Monel.

Non-overloading type diaphragm. Extreme accuracy. For high or low pressure.

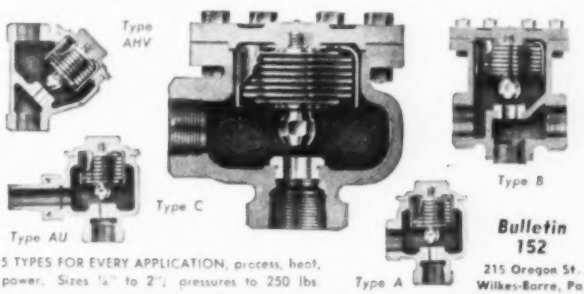
Write for Illustrated Bulletin

INSTRUMENTS, INC.
122 N. Madison Tulsa 6, Okla.

Nicholson Steam Traps

CUT HEAT-UP TIME 48%

A large processor recently reduced the heating cycles of cookers from 105 min. to 50-60 min., by substituting Nicholson thermostatic steam traps for a mechanical type. This effected a gratifying production increase of 37%. Reasons for Nicholson's faster heat transfer: operate on lowest temperature differential; 2 to 6 times average drainage capacity; maximum air venting. To learn why an increasing number of leading plants are standardizing on Nicholson thermostatic traps send for our catalog.



5 TYPES FOR EVERY APPLICATION; process, heat, power. Sizes ½" to 2"; pressures to 250 lbs.

Bulletin 152
215 Oregon St.
Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.
TRAPS · VALVES · FLOATS

(To obtain more data on advertised products see page 1344)

INTALOX*

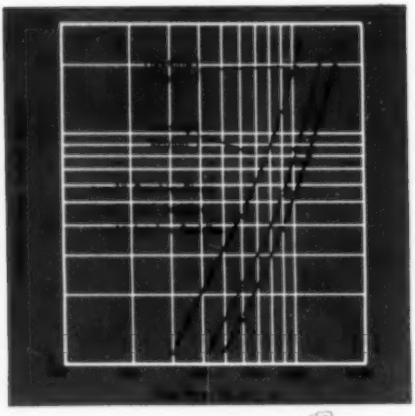
GIVES YOU

LOWER PRESSURE DROP

plus

- greater surface area
- more area accessability
- greater free space
- minimum "nesting"
- minimum "channelling"
- lower liquid "hold-up"
- higher flow capacities
- higher flooding limits
- lower side thrust
- lower weight

INTALOX is a new and unique, "saddle-type" tower packing. It's specifically designed to give you greater efficiency and lower costs in virtually any diffusional tower operation. It has many advantages over other "dumped" packings. Take, pressure drop, for instance. INTALOX has a 60-65% lower pressure drop than Raschig Rings — 30-35% lower than Berl saddles. INTALOX is available in chemical porcelain or stoneware and in, ½", ¾", 1" and 1½" sizes.



Learn more about INTALOX, today! Ask about our 116-page reference manual,

"TOWER PACKINGS AND PACKED TOWER DESIGN"

U. S. STONEWARE

* T. M. Reg. AKRON 9, OHIO. 461C

PROCESS EQUIPMENT DIVISION

What's New!

cludes description of "Hi-Lo" limit alarms and controls available as separate units or an integral part of the series transmitter. Vapor Recovery Systems Co., Compton, Calif.

Circle No. **25** *on Reply Card*

Maintenance Idea Book

1001 *Valuable Shortcuts With Hydraulic Tools and Hand Tools*, Bulletin No. 352; 64-page booklet pictures a collection of new applications for hydraulic equipment in production, maintenance, construction, laboratory and other fields; features tested uses of remotely-controlled hydraulic jack equipment and related products. Blackhawk Mfg. Co., Milwaukee 1, Wisconsin.

Circle No. **26** *on Reply Card*

Data Recorder-Annunciator

Sequential Automatic Data Recorder and Annunciator, Power Control Bulletin 101; 10 pages explains the recorder and annunciator with operational and functional description; includes special features, engineering data, uses, installation and application. Taller & Cooper Inc., Engineers Manufacturers, 75 Front St., Brooklyn 1, N. Y.

Circle No. **27** *on Reply Card*

Pipe Cutting Pantograph

Vernon Pipe Cutting Pantograph, Bulletin No. P-2; four pages describing and giving specifications of a semi-automatic guided torch machine which will produce straight or beveled cut-offs, saddle and insert-tee intersections, lateral intersections, and miters up to 22½°, on any length of pipe in most diameters from 2 to 24 in. Vernon Tool Co. Ltd., 1101 Meridian Ave., Alhambra, Calif.

Circle No. **28** *on Reply Card*

Dehumidifying Equipment

Because Moisture Isn't Pink, Bulletin No. 222; 29 pages describing principle of drying by absorption, followed by actual accounts where dry air was obtained and needed for such purposes as blanketing oil in storage and drying hydrocarbons in liquid or gaseous storage; covers need for dehumidifiers in the laboratory, chemical process and other industries. Pittsburgh Lectrodryer Corp., Pittsburgh 30, Pa.

Circle No. **29** *on Reply Card*

Thermometer Specifications

Recording Thermometers and Gauges, Dial Indicating Thermometers; Form No. G-158; eight-page catalog describes a complete line of recording thermometers and gages, dial indicating thermometers, applications, chart ranges, dial ranges and accessories; includes prices. The Electric Auto-Lite Co., Toledo 1, Ohio.

Circle No. **30** *on Reply Card*

Caustic Soda

Dow Caustic Soda, Form IC2A-452, 70-page book, newly revised, covering 1) manufacture of caustic soda, 2) chemical and physical properties, 3) economics involved, 4) methods of handling and storage, 5) technical data, 6) methods of analysis, and 7) first aid treatment for caustic burns. Dow Chemical Co., Midland, Mich.

Circle No. **31** *on Reply Card*

Pumps for Refinery Liquids

Process Pumps, Form 7091-A, 16-page bulletin describing single-stage, vertically split centrifugal pumps for handling light refinery liquids at temperatures to 250° F.; includes typical installations and approximate dimensions. Ingersoll-Rand Co., Dept. C. A. M., 11 Broadway, New York 4, N. Y.

Circle No. **32** *on Reply Card*

U. S. Lead Situation

The Dependability of Future Lead Supplies; 10-page leaflet discusses lead supply and consumption in the United States, shortage of lead in 1951, long-term outlook, estimated U. S. reserves, and sources of lead supply in recent years. Lead Industries Ass'n., 420 Lexington Ave., New York 17, N. Y.

Circle No. **33** *on Reply Card*

Acetylene vs. Ethylene

Acetylene—Coming Petrochemical Building Block? a 5-pg. reprint of an article describing recent developments in the manufacture and use of acetylene, originally published in July '52 issue of PETROLEUM PROCESSING. National Petroleum Publishing Co., 1213 West Third St., Cleveland 13.

Circle No. **34** *on Reply Card*

Pump Cups

Garlock Molded Cups, Bulletin AD-145; six-page folder covering various molded cups for pump pistons, hydraulic service and pneumatic equipment; includes service data and a complete list of sizes and part numbers. Garlock Packing Co., Palmyra, N. Y.

Circle No. **35** *on Reply Card*

Fluid Control Valves

Needle Valves, Oxygen-Gas Torches, Needle Valve Controls, Gas Pressure Reducing Valves, Bulletins D-170, D-171, D-172, D-173, D-174, D-175, D-176, D-178, D-179, D-180, D-181, D-182, D-183; 18 dimensional data sheets on a line of valves for fluid control. Hoke Inc., 161 South Dean St., Englewood, N. J.

Circle No. **36** *on Reply Card*

Recorders & Controllers

Electronic Strip-Chart, Dynamaster Potentiometers and Bridge Instruments, Bulletin P 1245; 36 pages describing single and multiple recorders, air and electric operated automatic controllers, and instruments for temperature, pH, speed, voltage, power, current, smoke density, strain, and resistance measurements. Bristol Co., Waterbury 20, Conn.

Circle No. **37** *on Reply Card*

Pipe Fittings

Fabricated Fittings By Naylor, Bulletin No. 525, four-page folder displays standard and light-weight pipe fittings, namely, elbows, tees, reducers, laterals, wyes, crosses, bends, manifolds, hoods, branches, and transitions; includes dimensions, also special fabrications which are available from 3-in. to 44-in. in diameter and up to ¼-in. in wall thickness. Naylor Pipe Co., 1230 East 92nd St., Chicago 19, Ill.

Circle No. **38** *on Reply Card*

Testing Plasticizers

Plastolein Plasticizers, Bulletin EM-761; 24 pages giving specifica-

Write for this new booklet on Alcoa Utilitube, the all-purpose aluminum tube that saves up to 40 per cent on tube costs. Booklet contains complete information on application, installation and service data . . . plus physical and mechanical properties.

Alcoa Utilitube is ideal for carrying air for instrument and brake lines—gasoline and fuel oil for internal combustion engines—lubricating oil for engines and machines—fluids for hydraulic systems.

Aluminum tube fittings are available from leading tube fitting distributors.

ALUMINUM COMPANY OF AMERICA
840-J Gulf Building • Pittsburgh 19, Pa.

(To obtain more data on advertised products see page 1344)

tions and properties of various plasticizers with considerable information on testing plasticizers including ultraviolet stability and heat stability; test methods described and various stabilizers recommended. Emery Industries Inc., Dept. 5, Carew Tower, Cincinnati 2, Ohio.

Circle No. **39** *on Reply Card*

Rubber and Instrumentation

Instrumentation, Vol. 6, No. 1, "Rubber for the Rolling Caissons," a two page article on General Tire and Rubber Co.'s Baytown plant, and their contribution to the government-sponsored rubber program; and a five page article on "Centralized Graphic Panels—Unlimited," which describes the advantages and growth of this type of process instrumentation. Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Aves., Philadelphia 44, Pa.

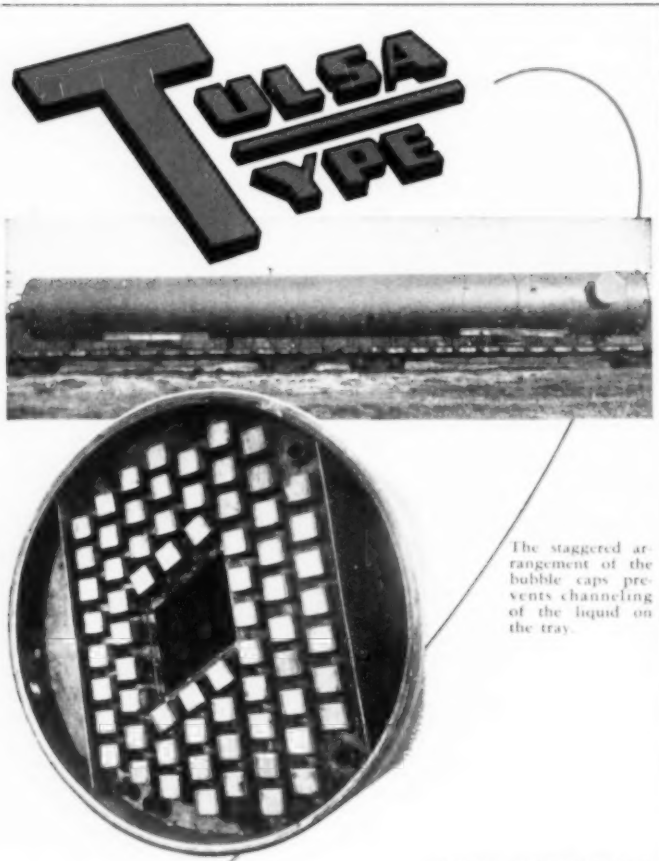
Circle No. **40** *on Reply Card*

Low Cost Oxygen Production

The Linde-Fraenkl Process, Catalog 2402; 24-page booklet describes process for the production of low-cost tonnage oxygen; furnishes flow diagram, history, advantages and cost of operation; includes physical properties of oxygen and nitrogen, temperature-entropy curves, and a questionnaire for obtaining further information. Write on company letterhead to Chemical Plants Div., Blaw-Knox Co., P.O. Box 778, Pittsburgh 30, Pa.

TRECO's Organization

Introducing The Refinery Engineering Company; 24 pages, with numerous photographs, tells the story and history of Refinery Engineering Co., including top management organizational stature, engineering and other departmental offices, and description of TRECO's work in the field. Write on company letterhead to Refinery Engineering Co., Tulsa, Okla.



The staggered arrangement of the bubble caps prevents channeling of the liquid on the tray.

TULSA TYPE Bubble Towers are BUILT RIGHT to accomplish the processing function required.

FLINT STEEL CORPORATION
TULSA, OKLAHOMA

Literature Offered in the Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature offered in this issue's advertisements:

ACTIVATED ALUMINA. Information offered by Aluminum Co. of America. See adv't p. 1202.

ADDITIVES, for industrial oils. Santolube Technical bulletin No. 0-56 offered by Monsanto Chemical Co. See adv't p. 1221.

AIR COOLERS. Bulletin offered by American Locomotive Co. See adv't p. 1339.

AIR PREHEATERS. Complete details offered by The Air Preheater Corp. See adv't pps. 1242-1243.

ALLOY EQUIPMENT. General Catalog offered by The Pressed Steel Co. See adv't p. 1262.

ALUMINUM BRONZES. Information offered by Ampco Metal, Inc. See adv't pps. 1248-1249.

BURNERS, oil-gas. Detailed literature offered by National Airoil Burner Co., Inc. See adv't p. 1305.

CATALYTIC CRACKING UNITS. Brochure offered by Texas Co. See adv't p. 1229.

COMPRESSORS centrifugal. Book offered by Carrier Corp. See adv't p. 1318.

DAMPENERS, pulsation. Bulletin PDS-540 offered by The Flour Corp., Ltd. See adv't p. 1249.

EXPANSION JOINTS. Bulletin 25-150 offered by American District Steam Co., Inc. See adv't p. 1250.

FANS, cooling tower. Information offered by Hartzell Propeller Fan Co. See adv't p. 1210.

FILTERS, for removal of water, scale, muck, air from light products. Bulletin FEQ-51 offered by Wayne-Lewis Co. See adv't p. 1317.

FILTERS, liquid. Folder D-11, offered by Industrial Corp. See adv't p. 1310.

FITTINGS, welding. Catalog offered by Globe Steel Tubes Co. See adv't facing p. 1288.

FLOW RATIO CONTROLLER: Complete information offered by Fischer & Porter Co. See adv't p. 1247.

FRACTIONATION: bubble-type Kaskade trays; Bulletin No. 629 offered by Koch Engineering Co., Inc. See adv't p. 1321.

GAGES, liquid level: Catalog 35 offered by Penberthy Injector Co. See adv't p. 1251.

GAGES, tank automatic: Bulletin CP-3500 offered by the Vapor Recovery Systems Co. See adv't p. 1358.

GEAR DRIVES, right angle: Catalog and engineering data offered by Johnson Gear & Manufacturing Co. See adv't p. 1348.

HEAT EXCHANGERS, finned-tube: Bulletin offered by Wolverine Tube Division. See adv't p. 1329.

HEAT EXCHANGERS, sectional baffles: Bulletin 481 offered by The Brown Fintube Co. See adv't p. 1234.

INSTRUMENTS, recording, controlling: Composite Catalog No. 5000 offered by Minneapolis-Honeywell Regulator Co. See adv't pps. 1230-1235.

MIXERS, side entering: Bulletin P-72 offered by International Engineering, Inc. See adv't p. 1338.

PACKING, removal hooks: Bulletin No. PH offered by Durametallic Corp. See adv't p. 1351.

PACKING, tower: 116-page reference manual offered by U. S. Stoneware. See adv't p. 1356.

PAINT, protective: Information offered by American Bitumuls & Asphalt Co. See adv't p. 1349.

PAINT, rust preventive: Complete literature offered by Rust-Oleum Corp. See adv't p. 1350.

PUMPS, cycling jet: Bulletin 5000 offered by Penberthy Injector Co. See adv't p. 1251.

PUMPS, electric: Bulletin 512 offered by Penberthy Injector Co. See adv't p. 1251.

PUMPS, sump, explosion-proof: Bulletin 4929 offered by Penberthy Injector Co. See adv't p. 1251.

RECORDER, oxygen: Information offered by The Hays Corp. See adv't p. 1325.

REFRACTORY LININGS: Brochure RC-283 offered by Johns-Manville. See adv't p. 1319.

REFRACTORIES, porous medium: Bulletin No. 140 offered by Norton Co. See adv't p. 1316.

STEAM TRAPS: Details offered by the Clark Manufacturing Co. See adv't p. 1352.

STEAM TRAPS: 20-page Bulletin offered by Yarnall-Waring Co. See adv't p. 1334.

SWIVEL JOINTS, ball-bearing: Catalog M-47 offered by Chiksan Co. See adv't p. 1232.

TANK CLEANING: Booklet F7629 offered by Oakite Products, Inc. See adv't p. 1359.

THERMOCOUPLES: Catalog 1 offered by Thermo Electric Co., Inc. See adv't p. 1313.

TRANSMITTER, pneumatic: Illustrated bulletin offered by Instruments, Inc. See adv't p. 1355.

TUBE CLEANERS: Complete details offered by Airtol Manufacturing Co. See adv't p. 1223.

TUBES, heat exchangers, aluminum: Booklet offered by Aluminum Co. of America. See adv't p. 1331.

TUBING, aluminum: Booklet entitled "Utiltube" offered by Aluminum Co. of America. See adv't p. 1331.

TURBINES, steam: Information and specifications offered by Dean Hill Pump and Turbine Engineers. See adv't p. 1237.

TURBINES, general purpose: Book B-4346 offered by Westinghouse Electric Corp. See adv't p. 1336.

VALVES, control: "Climax Controls Catalog" offered by Black, Sivalls & Bryson, Inc. See adv't p. 1333.

VALVES, control: Slide-rule type valve capacity calculator offered by Kieley & Mueller, Inc. See adv't p. 1224.

VALVES, gate: Descriptive circular AD-1881 offered by Crane Co. See adv't p. 1233.

VALVES, pump: New Catalog offered by Sims Pump Valve Co., Inc. See adv't p. 1353.

VALVES, safety: "5-Minute Brief" offered by Farris Engineering Corp. See adv't p. 1332.

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

*TWO low-cost ways to make salvage pay

Either way—tank immersion or steam-detergent cleaning—you save money when you reclaim used parts with job-designed Oakite cleaning and derusting materials. You speed up disassembly, inspection and repair. You save the expense of purchasing new parts . . . save time restoring old parts to condition.

Here's what you get with

*Tank immersion

*Steam-detergent cleaning

Tank immersion: Heavy-duty, long-lasting Oakite solution quickly removes grease, caked-on oil, waxy deposits. Excellent for degreasing piping, well tools, pump engines, motor parts, valves, etc. Tank also adaptable to cold solution cleaning with Oakite solvent-emulsion cleaners . . . derusting with specialized Oakite compounds.

Steam-detergent cleaning: Speedy cleaning of parts too large for solution tank. Removal of heavy, semi-loose deposits before tank-cleaning. Reduces boiling out time, insures longer solution life. Tops for cleaning when equipment urgently needed for production.

Ask your local Oakite Technical Service Representative for on-the-spot demonstration of these money-saving Oakite salvage methods. Or write for booklet F7629. FREE!

OAKITE PRODUCTS, INC., 48 Thames St., NEW YORK 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE

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PETROLEUM SERVICE DIVISION

(To obtain more data on advertised products see page 1344)

EDITORIALS

High Rate of Engine Wear

THE increased attention being given to engine wear by the automotive research departments of some oil companies and automobile manufacturers is more than justified. New data now coming to light point up the tremendous cost to the public of this factor in vehicle deterioration.

Statistically-minded investigators for Shell Oil Co. have estimated that each year 700 tons of iron are lost from the cylinder bores of American automotive engines through wear. This estimate is based on the assumption that the average cylinder-wear profile is equivalent geometrically to that found in laboratory studies. For every two ounces corroded or worn from cylinder bores an engine goes to dry-dock for extensive repairs. One billion dollars annually is given as a conservative figure for the cost to the public of this type of engine damage.

Mileage figures on engines coming into garages and engine rebuilding shops, obtained in a survey conducted by the Standard Oil Development Co., revealed that on the average the engine, without overhaul, lasts only half as long as the car. Engine wear is now considered the limiting factor in engine life, which in turn is the chief limiting factor in the life of an automobile.

The work on this subject done by Standard Oil Development Co., with the aid of new laboratory techniques and methods of check, points strongly to the possibility that friction between cylinder walls and piston rings is a much larger factor in engine wear than has been assumed. This conclusion is at variance with the findings of other investigators to the effect that corrosion is the principal cause.

Whether the new findings throwing the onus for high rate of wear largely on friction are supported or disproved in later work, the SOD research staff has made a valuable contribution in focussing greater attention on this cause of engine failure. This should be a big step toward further improved lubricants.

—V.B.G.

Industrial Greatness

THAT any industrial concern in the U. S., where the pace of technological and economic progress has been so swift as to leave stranded many individual businesses and even industries, should enjoy an unbroken span of activity of 150 years is noteworthy. That the particular enterprise should have risen to the importance of the du Pont company makes its 150th anniversary even more dramatic.

When Eleuthere Irence du Pont came from France and started his first black gunpowder mill on Brandywine Creek, near Wilmington, Del., in 1802, there were many other going business activities in the country, young though it was. What was it about that particular enterprise, and its founder, that brought it through wars and depressions to its status in the chemical manufacturing business today? The answer may be found perhaps in a statement in a current autobiography of this American enterprise, to the effect the guiding philosophy of the du Pont family has been that there is no privilege that is not inseparably bound to a duty. Thus, while the company from the start was a family business, the family personal interests were subordinated to the progress and best interests of their enterprise.

The unbroken activity of the family as guiding hands for the business undoubtedly contributed a continuity of purpose and policy that has been a large factor in its success. It does not fall to many institutions to have a continuing active family interest over many decades. Businesses today might find some means, however, to instill in themselves the tenacity of purpose that has been characteristic of the du Pont enterprise.

—V.B.G.

Tri-State Pollution Report

THE Interstate Sanitation Commission has just issued its report "Industrial Waste Inventory of the Interstate Sanitation District." The Commission was formed in 1935 by the Tri-State Compact, of New York, New Jersey and Connecticut, for the purpose of controlling pollution of the waters of the tri-state area. These waters include New York Harbor, Long Island Sound, the Hudson River and the shore waters of the Atlantic ocean in this area. They serve approximately 11,000,000 persons with recreational facilities and provide industry with an abundant source of cooling and process water.

The Commission expects to have its work of controlling domestic wastes discharged into the District waters well along toward completion by 1953, when it expects that 75% of the domestic sewage will meet the standards it has set up for minimum pollution load. It has launched its program in the control of industrial wastes with a survey to determine the sources, volumes, characteristics and strengths of these wastes discharged directly into District waters through private sewers.

The survey discloses that 306 plants among the 1500 on the coastline bordering the Interstate Sanitation District discharge directly into adjoining surface waters a volume of approximately 515,000,000 gals. per day of industrial waste. Some degree of treatment before discharge is given in 138 plants to the relatively high proportion of 443,000,000 gals. While only 5% of the number of establishments surveyed are petroleum plants, they are reported as accounting for 65% of the waste discharged. The petroleum plants, however, lead in the treatment of waste, 99.9% of their waste undergoing some form of treatment before discharge.

The Commission has a difficult and important task in recommending to the three states of the Interstate Sanitation District minimum standards of pollution for industrial wastes discharged into the waters off their shores. The petroleum and other plants have likely done far more work themselves in waste control than the Commission appreciates from its work to date with the sources of domestic waste. The Commission should enlist industry cooperation widely to insure a practical waste control program for this extensive connected water area.

—V.B.G.

CHEMICAL USERS' GUIDE

to General Chemical Products for the Petroleum Industry

ALKYLATION

ANHYDROUS HYDROFLUORIC ACID
Grades or Strengths: 99.0% HF min. (one grade only)
Packing: Steel Cylinders, Tank Cars

SULFURIC ACID
Grades or Strengths: Standard
66° Baume—93.19% H_2SO_4
99% H_2SO_4
Diamond—66° Baume
Crystal—66° Baume
Packing: Tank Barges, Steel Tank Cars, Steel Tank Trucks, Steel Drums, also Carboys

POLYMERIZATION or ALKYLATION

FLUOSULFONIC ACID—HO SO F (HSO F)
Grades or Strengths: Min. Content 98% Fluosulfonic Acid
Packing: Steel Tank Cars, Steel Drums

BORON TRIFLUORIDE
Gas: Cylinders
Etherate Complex: 47.9% min. BF$_3$. Packing: Steel Drums, Tank Trucks, Tank Cars
Phenol Complex: 26.3% Max. BF$_3$. Packing: Steel Drums, Tank Cars
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SULFAN® "B" (Stabilized Sulfuric Anhydride)
Grades or Strengths: 99% SO_3 min.
Packing: 55 Gal. Drums, Tank Cars

OLEUM
Grades or Strengths: 15% free SO_3 (103.38% H SO_4)
20% free SO_3 (104.5% H SO_4)
65% free SO_3 (114.38% H SO_4)
Packing: Steel Drums, Tank Cars, Tank Barges, Tank Trucks

ISOMERIZATION

MURIATIC ACID (Hydrochloric)
Grades or Strengths: Standard—18°, 20°, and 22° Baume
Packing: Rubber-lined Tank Cars, Rubber-lined Tank Trucks, also Carboys

DETERGENTS & BUILDERS

SODIUM METASILICATE
Grades or Strengths: Granular, thru 10 mesh; Powdered, 90% thru 40 mesh
Packing: Multiwall Paper Bags, Fibre Drums

DISODIUM PHOSPHATE
Grades or Strengths: Anhydrous
Packing: Multiwall Paper Bags, Fibre Drums

SODIUM SULFATE, Anhydrous
Grades or Strengths: Standard, approximately 99.5% Na_2SO_4
Packing: Multiwall Paper Bags

TRISODIUM PHOSPHATE
Grades or Strengths: Coarse, thru 10 on 20 mesh; Medium, thru 20 mesh on 100 mesh; Standard, thru 20 mesh, 15-25% thru 100 mesh; Fines, thru 40 mesh, 50% thru 100 mesh; Flake
Packing: Multiwall Paper Bags, Fibre Drums

TETRASODIUM PYROPHOSPHATE
Grades or Strengths: Anhydrous, Powdered, 100% thru 20 mesh, 90% min. thru 100 mesh
Packing: Multiwall Paper Bags, Fibre Drums

SODIUM TRIPOLYPHOSPHATE
Grades or Strengths: Anhydrous, Powdered, 90% thru 100 mesh; Granular, 95% thru 20 mesh
Packing: Multiwall Paper Bags, Fibre Drums

ACIDIZING

MURIATIC ACID (Hydrochloric)
HYDROFLUORIC ACID

MUD CONDITIONING

SODIUM SILICATE
Grades or Strengths: Clear and Opalescent Grades in a wide range of viscosities ranging from 38° to 60° Baume
Packing: Steel Drums, Tank Cars, Tank Trucks
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TRISODIUM PHOSPHATE
TETRASODIUM PYROPHOSPHATE (TSPP)
SODIUM TRIPOLYPHOSPHATE

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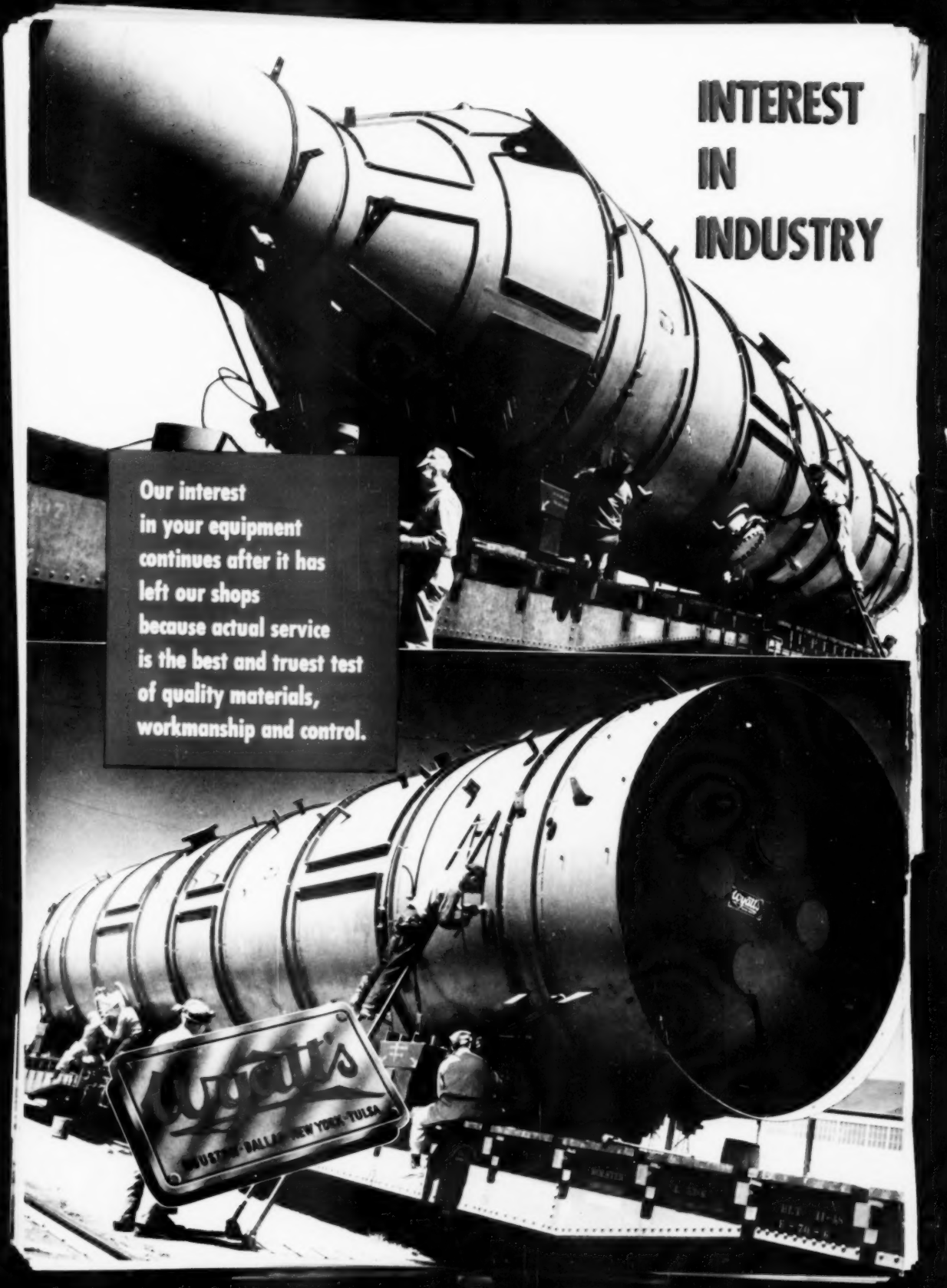
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